NOTICE

All drawings located at the end of the document.

Type 1 Facility Closeout Report

COPY

Section A. Facility Data

Facility No.:	Building 111 Project
Facility Descriptor:	Building 111 Administration, Building 333 Paint Shop and 132 Substation Pad
Project:	Building 111 Project
Date of Demolition:	Building 111 - November 15, 2001 to November 20, 2001
	Building 333 - November 9, 2001 to November 14, 2001
	132 Pad - November 7, 2001 to November 9, 2001
Additional Information	(1) Building 111 basement left in place with walls taken 3 feet below grade Area has been filled with backfill, topsoil and has been revegetated Fire and domestic water feed lines were grouted and plugged Sewer drain lines were plugged and/or grouted Footer drain disruption work was determined to not be required (Attachment 1)
	(2) Building 333 area filled with soil and has been revegetated Fire and domestic water feed lines were plugged Sewer drain was disrupted and grouted
	(3) 132 Pad area filled with backfill Area to have gravel placed on top for future use such as cargo container storage

(Must include information on environmental releases and conditions of site at turnover to Environmental Restoration)

Section B. Final Characterization Data

Reconnaissance Level Characterization Report *(concurrence received)*	Date of concurrence - April 10, 2001
In-process Characterization	(1) Post demolition survey report (Attachment 2)
	(2) Air Monitoring Results for Rocky Flats Building 111 Demolition, Dated January 14, 2002 (Attachment 3)
Pre-Demolition Survey Report *(approval received)*	None required - Type I Facility
Post-Demolition Survey Report *(as necessary)*	None required - Type I Facility

Section C. Waste Data *(complete categories as appropriate)*

Sanitary Disposal	Construction Debris
Disposal Site:	Front Range Landfill, 1830 Weld County Road 5, Erie CO
Waste Volume (m^3):	N/A - Tonnage reported
Waste Weight (tons):	5947 8 tons
Additional Information	Includes concrete
Hazardous Waste	Mercury switches
Disposal Site:	Superior Special Services, 5752 West Jefferson, Phoenix, AZ
Waste Volume (m^3):	0 04 m^3
Additional Information	WEMS X28119
Hazardous Waste	Fluorescent Lamps
Disposal Site:	Superior Special Services, 5752 West Jefferson, Phoenix, AZ
Waste Volume (m^3):	1 04 m^3
Additional Information	1 ton - WEMS DC4587, N05352, N05333, N05355, N05356
TSCA Waste Disposal	PCB Oil
Disposal Site:	Superior Special Services, 5752 West Jefferson, Phoenix, AZ
Waste Volume (m^3):	0 1 m^3 (25 gallons)
Additional Information	WEMS R02169

Continued on next page

1/37

TSCA Waste Disposal	PCB Transformer Item
Disposal Site:	Superior Special Services, 5752 West Jefferson, Phoenix, AZ
Waste Volume (m^3):	N/A - Tonnage reported
Additional Information	0 15 tons - WEMS X29484
TSCA Waste Disposal	PCB Ballasts
Disposal Site:	Superior Special Services, 5752 West Jefferson, Phoenix, AZ
Waste Volume (m^3):	0 67 m^3
Additional Information	1 2 ton - WEMS DC4585, N05354, T01203, T01204
Asbestos Waste Disposal	Friable Asbestos
Disposal Site:	CWM Kettleman Hills Facility, 35251 Old Skyline Road, Kettleman City, CA
Waste Volume (m^3):	N/A - Tonnage reported
Additional Information	34 7 tons
Asbestos Waste Disposal	Non-Friable Asbestos
Disposal Site:	Front Range Landfill, 1830 Weld County Road 5, Erie CO
Waste Volume (m^3):	N/A - Tonnage reported
Additional Information	136 6 tons
Low-Level Waste Disposal	None
Disposal Site:	N/A
Waste Volume (m^3):	N/A
Additional Information	N/A
Low-Level Mixed Waste Disposal	None
Disposal Site:	N/A
Waste Volume (m^3):	N/A
Additional Information	N/A
Recycled Material	Non-painted scrap metal debris
Disposal Site:	Iron & Metals, Inc , 5555 Franklin, Denver, CO
Waste Volume (m^3):	N/A - Tonnage reported
Additional Information	109 6 tons
Recycled Material	Non-PCB Oil
Disposal Site:	Onyx Environmental Services, 9131 E 96th Ave, Henderson, CO
Waste Volume (m^3):	4 45 m^3
Additional Information	4 3 tons - WEMS 29434
Recycled Material	Lead Acid Batteries
Disposal Site:	Gopher Resource Corp , 3385 South Highway 149, Eagan, MN
Waste Volume (m^3).	N/A - Tonnage reported
Additional Information	0 075 tons
Recycled Material	Propyleneglycol
Disposal Site:	On-site
Waste Volume (m^3):	0 208 m^3
Additional Information	1 - 55 gallon drum

Continued on next page

2

Recycled Material	Concrete
Disposal Site:	Rocky Flats Environmental Technology Site Concrete Pile East of Building 750
Waste Volume (m^3):	Tonnage reported
Additional Information	150 tons
Recycled Material	Circuit Boards
Disposal Site:	Vendor Sale
Waste Volume (m^3):	N/A - Tonnage reported
Additional Information	0 04 tons
Property Disposition	Facility emptied prior to asbestos abatement and demolition
Receiver Locations *(major items only)*	Transferred to other facilities for re-use of to Building 061 for auction
Waste Volume (m^3):	N/A
Waste Weight (tons):	N/A
Additional Information	None

Section D. Approvals

Kaiser-Hill Project Manager

Name/Signature: [signature] Date: 04/12/02

3

ATTACHMENT 1

Footer Disruption Letter to File

4

KAISER ◆ HILL
COMPANY

COPY

INTEROFFICE MEMORANDUM

DATE	April 11, 2002
TO	File, Administrative Record
FROM	C J Freiboth, K-H 400 Area Project Manager, x2823
SUBJECT	BUILDING 111 FOOTER DRAINS - CJF-001-02

Planning activities for the demolition of Building 111 included plans to disrupt the footer drain system installed during the construction of Building 111, or during subsequent modifications to the facility A Work Request was submitted to have this work completed (Reference T01080690-142) Drawings D25581-1 and D25581-8 (attached) were used as the starting point to determine the most efficient and effective way to disrupt the flow from this drainage system Meetings with Annette Primrose and Dyan Foss determined that disruption of the flow path to the north of the former site would be the best way to proceed

Based on this direction, a walk-down was conducted on April 11, 2002, with the following personnel to determine where to best disrupt the system

Gary Parson, Steve Mobley	Site Utilities	Cameron Freiboth	B111 PM
John Caves	TP Enterprise	Steve Hintze	Roads and Grounds

During this walk-down it was determined that the footer drain system was disrupted during the construction of Building 115 The drain system was located to the east of the Building 111 site and was tracked north to the sidewalk along the south side of Building 115 The path of the system was found to be 12 feet to the east of the south-west corner of Building 115 At the point where the sidewalk ended and gravel was placed, the system stopped (not located) The drainage system was pickup up again, 3 feet to the north of Building 115, 12 feet from the north-west corner of Building 115 (see attached drawings)

The disruption of this system is further supported by the fact that during asbestos abatement activities, the sump system located in the south mechanical room of Building 111 was frequently pumped due to the accumulation of ground water (log-sheet attached), which was an indication that the footers were draining into the sump system via the elevator shaft As shown on DOW DWG 1-1687-11 (attached), water accumulated in the elevator shaft located on the southeast corner of Building 111 and drained (green line) into the mechanical room sump (blue area) The sump was then pumped in above ground pipes (orange line) to Manhole A (pink) located to the west of south part of the Building 111 basement The pipe in this manhole were sealed with grout during the demolition of the facility The orange piping was removed during demolition Therefore, the flow path of the ground water was disrupted during facility demolition

To verify that the elevator shaft was the only source of water into the mechanical room sump, the drain was plugged on two different occasions in May and June 2001 In both cases, the water into the elevator shaft backed up to a depth of approximately 1 foot, while the sump had no accumulation of water

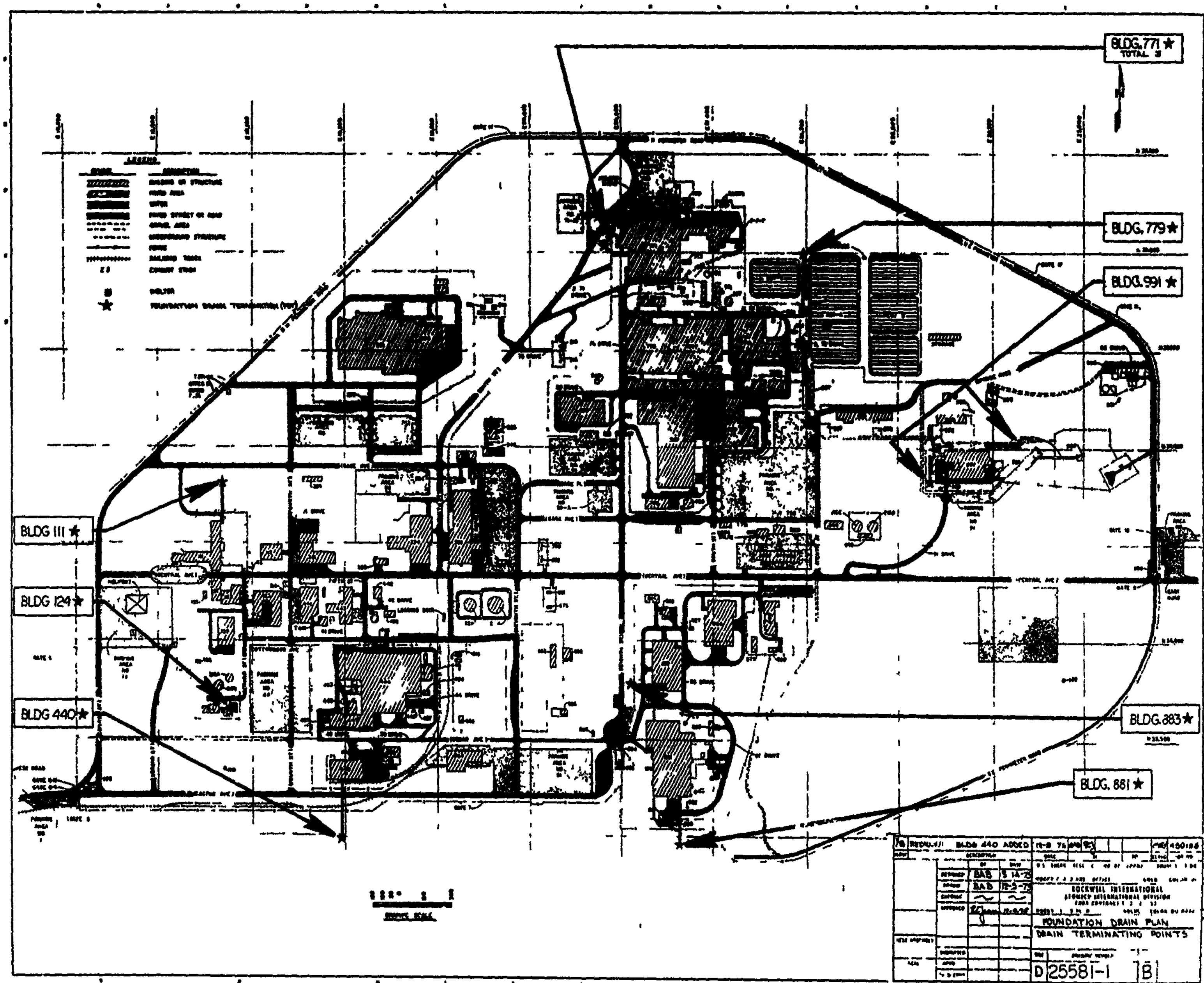
Based on the walk-down and as further supported by the above information, it is agreed that the footer drain system for Building 111 has been disrupted, is no longer active and no further actions are required

CJF/cjf

Attachments
As Stated

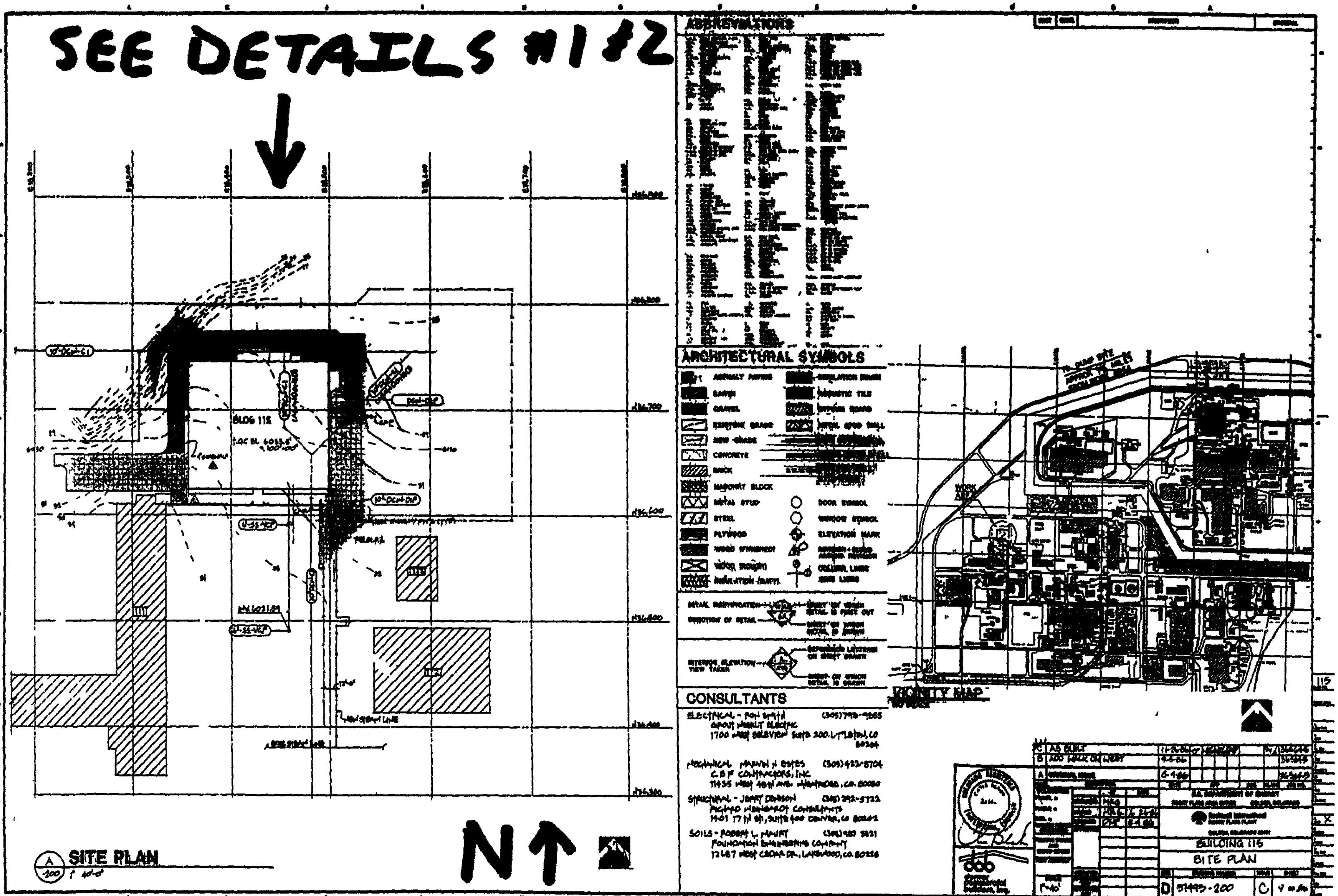
5

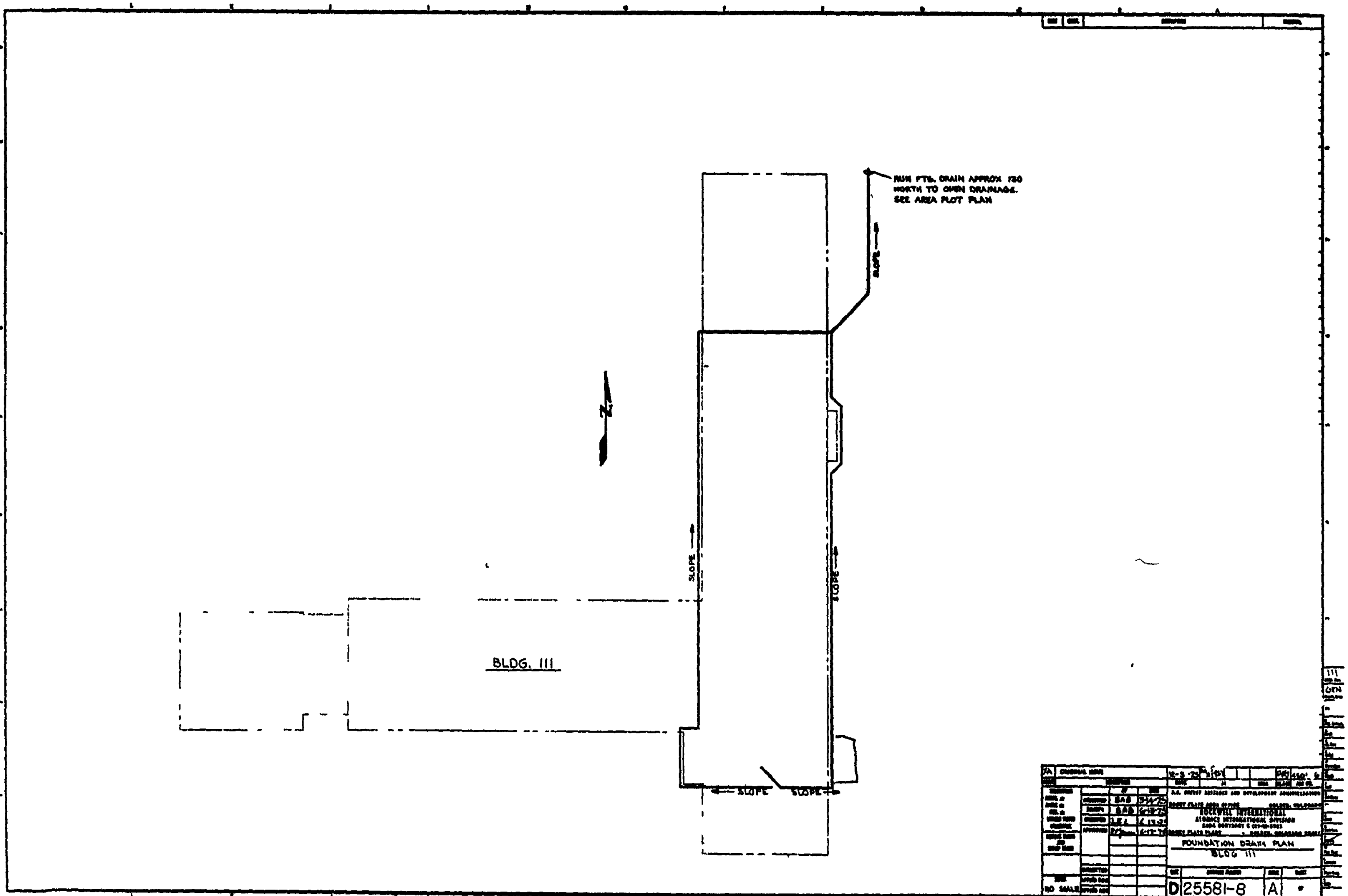
"SAFETY IS CRITICAL TO OUR SUCCESS"



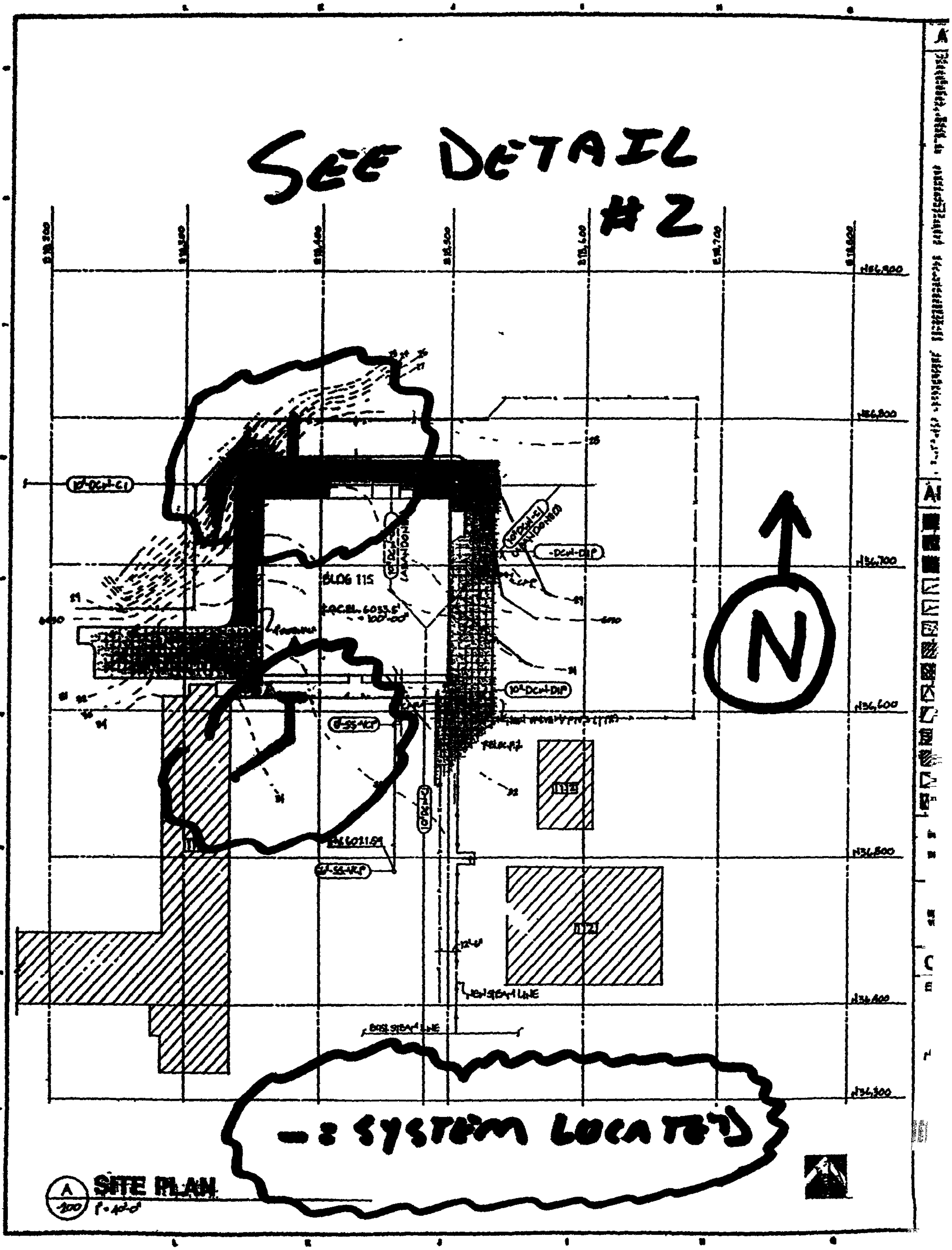
BLDG. 771 ★
TOTAL 3
BLDG. 779 ★
BLDG. 991 ★
BLDG 111 ★
BLDG 124 ★
BLDG 440 ★
BLDG. 883 ★
BLDG. 881 ★
BLDG 440 ADDED
BAB
ROCKWELL INTERNATIONAL
FOUNDATION DRAIN PLAN
DRAIN TERMINATING POINTS
D 25581-1
B

6


SEE DETAILS #1 #2
BLDG 115
SITE PLAN
N
ABBREVIATIONS
ARCHITECTURAL SYMBOLS
CONSULTANTS
ELECTRICAL - RON SMITH (303)798-9265
1700 WEST BELLEVIEW SUITE 200, LITTLETON, CO
MECHANICAL MARVIN H ESTES (303)422-8704
C B F CONTRACTORS, INC
STRUCTURAL - JEFF DENISON
1401 17TH ST, SUITE 400 DENVER, CO
SOILS - ROBERT L. MAURY
FOUNDATION ENGINEERING COMPANY
LAKEWOOD, CO.
VICINITY MAP
C AS BUILT
B ADD WALK ON WEST
A ORIGINAL ISSUE
BUILDING 115
SITE PLAN
1"=40'
D 51493-200 C

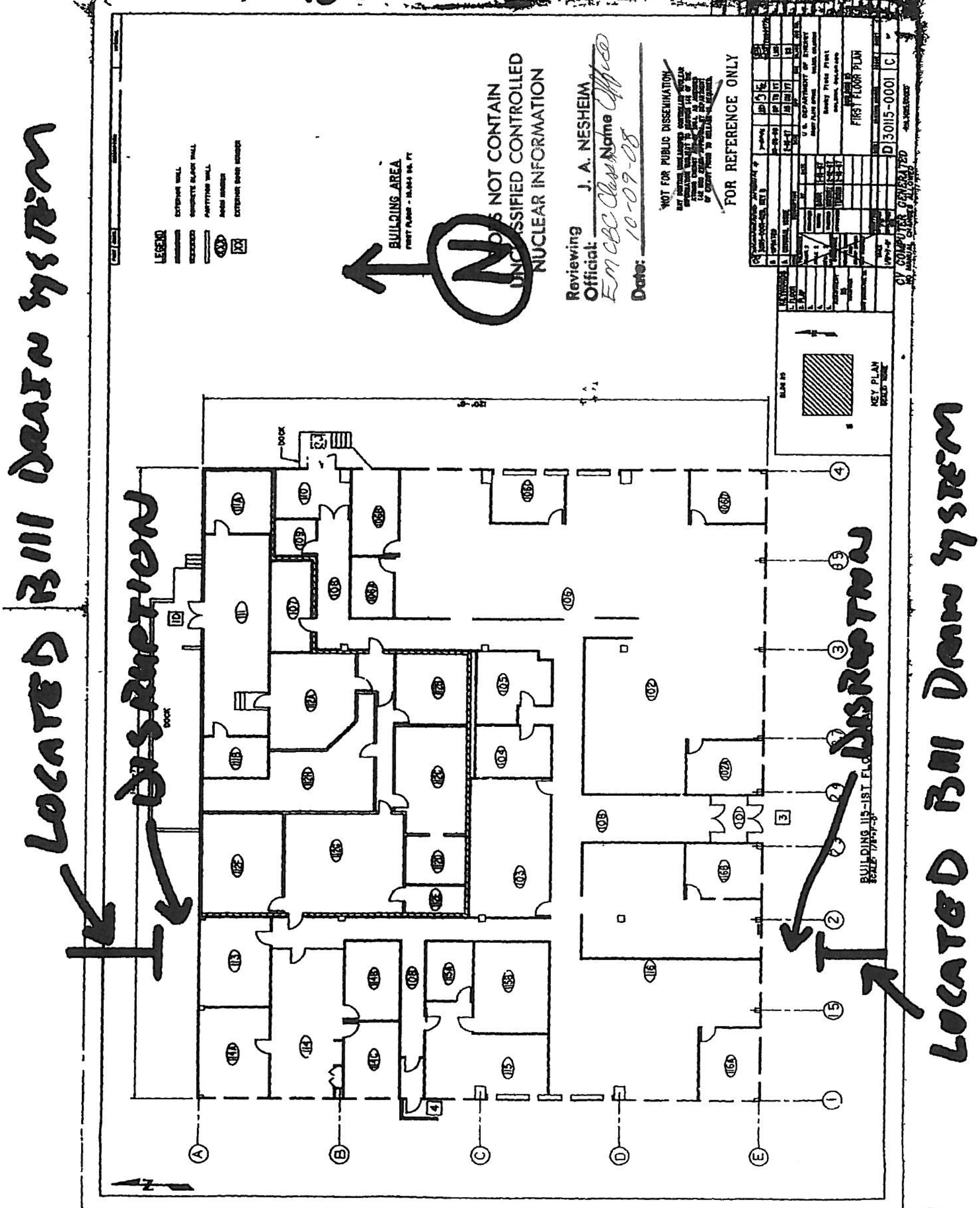

RUN FTG. DRAIN APPROX 120
NORTH TO OPEN DRAINAGE.
SEE AREA PLOT PLAN
SLOPE
SLOPE
SLOPE
SLOPE
SLOPE
N
BLDG. 111
ROCKWELL INTERNATIONAL
FOUNDATION DRAIN PLAN
BLDG 111
NO SCALE
D 25581-8
A

DETAIL #1

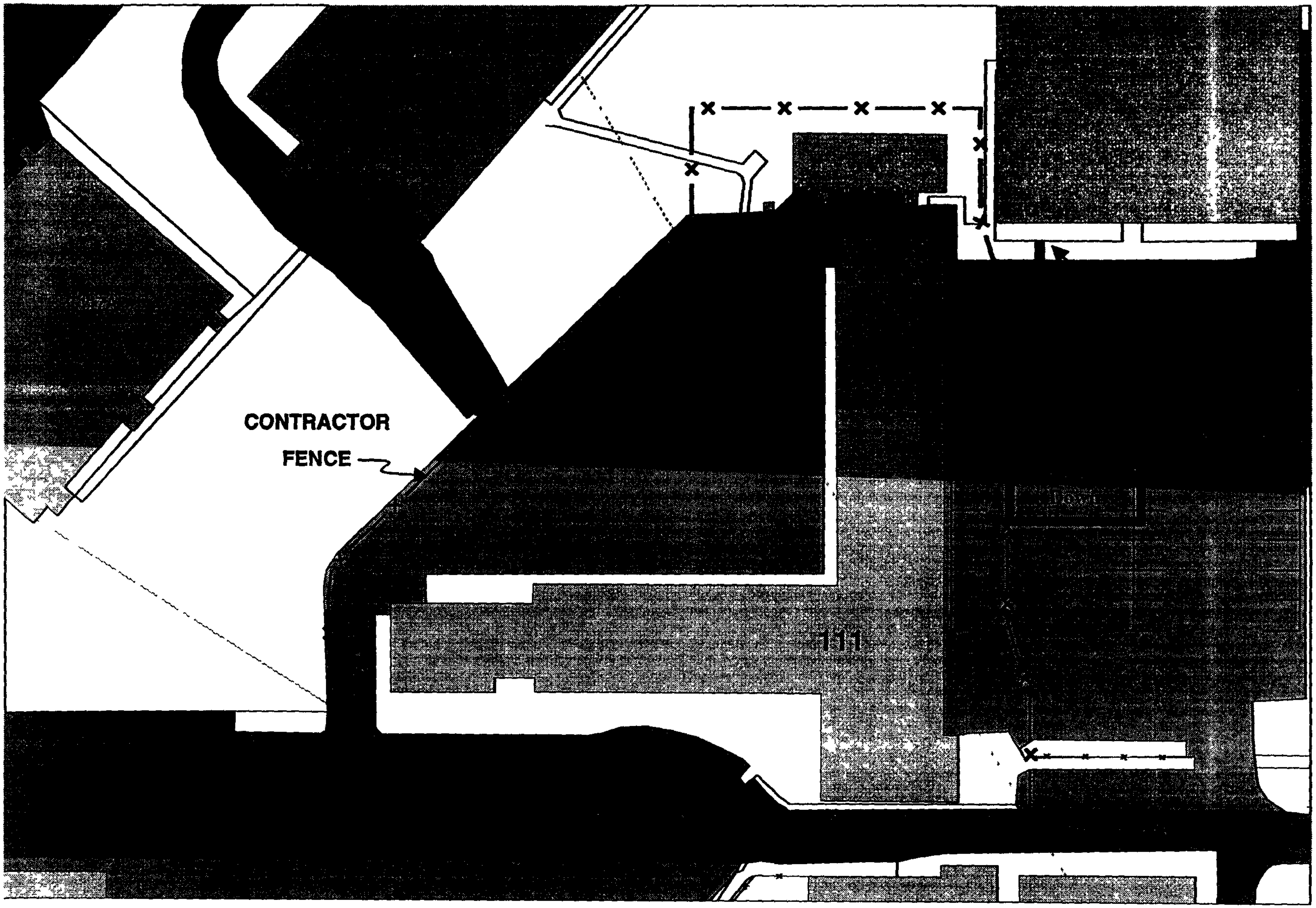


9

DETAIL #2



LOCATED B111 DRAIN SYSTEM
DISRUPTION
LEGEND
BUILDING AREA
DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
Reviewing Official: J. A. NESHEIM
Date: 10-09-08
FOR REFERENCE ONLY
FIRST FLOOR PLAN
D 30115-0001 C
COMPUTER GENERATED
NO MANUAL CHANGES ALLOWED
KEY PLAN
DOCK
DISRUPTION
LOCATED B111 DRAIN SYSTEM



NOTE: SEE ADDITIONAL DRAWINGS FOR CLARIFICATIONS

BUILDING 111 SUMP DATA

Date	Time Pump On	Time Pump Off	Comments
5/10/01	1045	1130	GFCI is wet - Water ~ 4" above drain
5/14/01	1025	1035	GFCI working fine - Water ~ 2 ft above sump top
5/20/01	935	1002	GFCI working fine - Water ~ 3" above drain floor
5/22/01	950	1010	GFCI working fine - Water ~ 3" above drain floor
5/27/01	1331	1351	GFCI working fine - Water ~ 3" above drain floor
6/2/01	1301	1316	GFCI working fine - Water ~ 2" above drain floor
6/8/01	906	921	GFCI working fine - Water ~ 2" above drain floor
6/16/01	755	805	GFCI working fine - Water ~ 2" above drain floor
6/18/01	1625	1635	GFCI Working Fine - Completed pumping sump
6/30/01	1325	1340	GFCI working fine - Water ~ 2" above drain floor
7/11/01	625	642	GFCI working fine - Water ~ 3" above drain floor
7/16/01	550	630	GFCI working fine - Water ~ 2" deep near ramp
7/20/01	815	840	GFCI working fine - Water ~ 3" above drain floor
7/28/01	750	805	GFCI working fine - Water below drain
8/5/01	1623	1634	GFCI working fine - Water below drain
8/10/01	557	623	GFCI working fine - Water ~ 4" above floor drain
8/13/01	637	657	GFCI working fine - Water ~ 2" above floor drain
8/17/01	610	630	GFCI working fine - Water ~ 2" above floor drain
8/24/01	608	632	Used new GFCI - Water below drain
9/1/01	832	840	Used new GFCI - Water below drain ~ 4 feet deep
9/9/01	917	939	GFCI working fine - Water ~ 2" above floor drain
9/13/01	1641	1651	GFCI working fine - Water ~ 2" above floor drain
9/16/01	1524	1540	GFCI working fine - Water ~ 1" above floor drain
9/29/01	807	822	GFCI working fine - Water ~ 2" above floor drain
10/6/01	1513	1529	GFCI working fine - Water ~ 2" above floor drain
10/14/01	1331	1338	GFCI working fine - Water below drain
10/21/01	1605	1615	GFCI working fine - Water below drain
10/28/01	756	801	GFCI working fine - Water below drain
11/8/01	658	708	GFCI working fine - Water below drain

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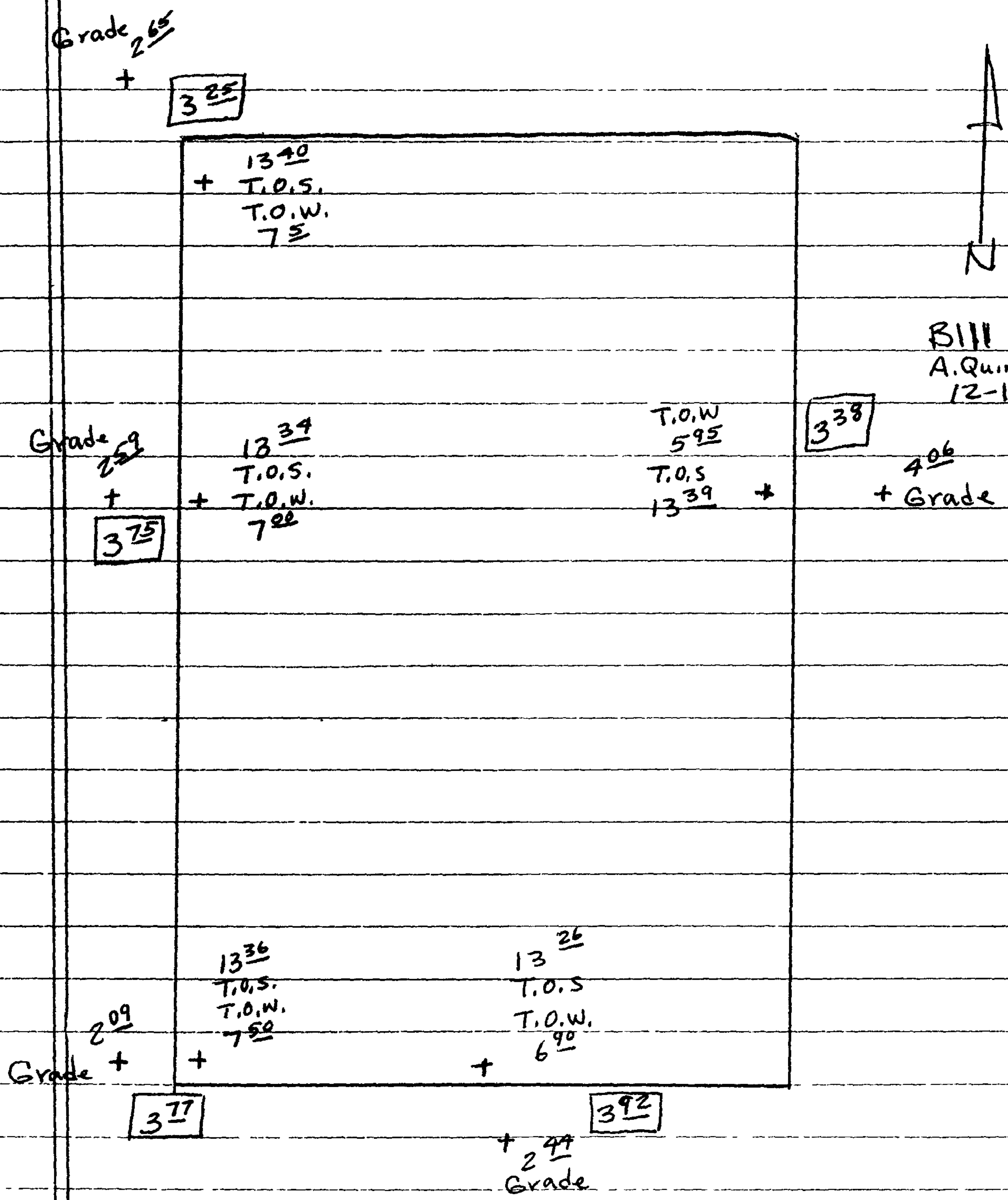
ATTACHMENT 2

Post Demolition Survey Report

14

B111 D+D
A.Quintana
12-17-01



T.O.S. = Top of Slab

T.O.W = Top of Wall

$\boxed{X^{xx}}$ = Diff. in elevation

ATTACHMENT 3

Air Monitoring Results for Rocky Flats Building 111 Demolition

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
Laboratory and Radiation Services Division
Radiation Counting Facility

Air Monitoring Results for Rocky Flats Building 111 Demolition

From L Tony Harrison Date January 14, 2002

In an effort to detect and quantify releases of radioactive material from building demolition at RFETS, a pilot study was conducted around the Building 111 demolition project to determine whether meaningful data could be acquired and processed in a time period that would be useful to regulators and stakeholders. This project was motivated by the desire, expressed to the regulators by various stakeholders [1], for real-time, sensitive measurements of radioactive material in air during demolition of historically contaminated buildings None of the sensitive technologies considered was capable of distinguishing isotopes of Pu or U quickly, especially in the presence of radon and its decay products Continuous Air Monitors (CAM) of the type used in plutonium production buildings have been shown to be less sensitive than needed for this project This situation led to a number of compromises, resulting in the current pilot study Additional discussion of the difficulty of measuring low levels of long-lived alpha emitters in the presence of natural airborne radioactivity is presented in Appendix A

Building 111 was a reinforced concrete office building at Rocky Flats that had never been used for work with radioactive material [2] Demolition was expected to take place over two weeks, and removal of building rubble was expected to occur over the following week Air sampling was scheduled to begin one week before demolition and continue for one week after the end of the project. Thus it is believed that any measurable radioactivity in air from demolition would serve as a baseline for monitoring the demolition of previously contaminated buildings in the future Data Quality Objectives (DQO's) were written as if this was the demolition of a contaminated building, but project staff had flexibility to maximize the information gained

Building Demolition Data Quality Objective:

Inputs

Monitored results of gross alpha radioactivity in air
Adequate gross alpha baseline data and defensible estimates of normal variation
Adequate QA/QC measures on sampling equipment and laboratory analyses

Boundaries

Spatial – Six sample locations in an approximately circular array around the building to be demolished All samplers to be no less than 50 meters and no more than 200 meters from the nearest exterior wall of the building to be demolished

Temporal – Sample collection will begin one week prior to building demolition and continue for at least one week after the demolition is complete. During demolition samples will be collected for one hour prior to the commencement of work, and for one hour after work ends Total daily sample duration will be variable, depending on the work schedule of the demolition contractor All samples will be aged for 72 hours in order to allow decay of radon progeny

Decision statements

IF any gross alpha measurement exceeds the modeled concentration corresponding to 0 1 mrem dose for the duration of the project

THEN the sample will be analyzed for Pu, Am and U isotopes via alpha spectrometry or other appropriate method

IF isotopic analysis indicates that more than 25% of the gross alpha activity is due to Pu, Am and/or U isotopes

THEN project management, regulators, stakeholders and other parties are informed of an unexpected release

METHODS:

Six USPHS-type total suspended particulate (TSP) high volume air samplers, calibrated to draw 40 cubic feet per minute (CFM), were deployed in a roughly circular array around Building 111 at distances ranging from approximately 65 to 105 meters from the building centerpoint Sampling began on November 7, 2001 and demolition began on November 14 Sampling was conducted daily fom approximately 6·30 AM to 5:30 PM. Samples were collected on 8x10 quartz filters that were delivered to the laboratory at the end of each day The filters were weighed under controlled conditions and counted for 50 minutes with a Gamma Products proportional counter after approximately 72 hours to determine gross alpha/gross beta radioactivity concentrations

Results were compared to concentrations modeled by RFETS staff as being equal to dose limits of 0 1, 1 and 5 mrem per year These values were developed [3] using conservative assumptions, including

- all alpha activity was due to Pu-239
- exposures continued for an entire year
- minimal dilution between the source of the release and the receptor

These limits are shown in Table 1

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Table 1 – Gross Alpha Action Levels

Sampler (Direction)	Sampler Distance (m)	5 mrem action level (pCi/m^3)	1 mrem action level (pCi/m^3)	0.1 mrem action level (pCi/m^3)
B1 (N)	95	1.10	0.22	0.022
B2 (ENE)	68	2.80	0.55	0.055
B3 (ESE)	70	2.90	0.59	0.059
B4 (SSW)	64	1.50	0.31	0.031
B5 (SW)	105	0.52	0.10	0.010
B6 (W)	95	0.49	0.099	0.0099

Samples were also counted after 96-120 hours, depending on the availability of the proportional counter. The second count was performed for 120 minutes per sample when possible, in order to obtain a lower detection limit. These results were also compared to the concentrations in Table 1.

On November 28th, station B3 was relocated approximately 6-7 meters southeast of its original position to accommodate another Site project. Demolition and removal of rubble was not completed until December 14, 2001, while backfilling of the basement took place at least through December 20th. Air sampling continued until December 20, 2001.

RESULTS:

Figure 1 shows the average gross alpha radioactivity results from the 72 hour counts for each day, along with the maximum and minimum result for the day and the average Minimum Detectable Activities (MDA). Figure 2 shows the comparable results for the gross beta radioactivity. Figures 3 and 4 show the comparable results for the second count at 96-120 hours. Henceforth this dataset will be referred to as 100 hour data. No filters were rejected as unusable during the project.

Figures 5 through 10 show the 72 hour gross alpha data for the individual sampling stations, along with their respective MDAs. At each station we see gross alpha activity that exceeds the 0.1 mrem level. Since this level varies from station to station, the number of exceedences varies from station to station, and those stations with the lowest 0.1 mrem values have the most exceedences. Figure 11 compiles all 72 hour measurements on one graph.

Figures 12 through 17 show the 100 hour gross alpha data for the stations, and Figure 18 shows the compiled 100 hour data. Nearly all measurements are below their respective MDA's. MDA's are well below the 0.1 mrem limit at all stations except 5 and 6. Limits for these samplers are significantly lower than for the others due to the shorter distances in their respective directions to the nearest offsite receptors.

Gross alpha results for the 72 hour count data are summarized in Table 2.

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Table 2 – 72 hour Gross Alpha Results

Sampler	Mean Conc (pCi/m^3)	Max Conc (pCi/m^3)	Min Conc (pCi/m^3)	MDA (pCi/m^3)
B1	0.042	0.140	0.001	0.023
B2	0.039	0.115	-0.002	0.022
B3	0.037	0.088	0.001	0.023
B4	0.037	0.120	-0.005	0.022
B5	0.029	0.084	-0.004	0.025
B6	0.037	0.185	-0.006	0.020

As shown in Figure 1, a couple of anomalous results were seen. Data for the 27th of November were comparable to instrument background count results, and mean net count rates were significantly lower after 72 hours than after 100 (-0.17 cpm and 0.19 cpm, respectively), a pattern that was not seen in samples for any other day. All instrument Quality Control parameters were acceptable, and there is no other reason to doubt the results.

The extremely high reading for Station B6 on December 5th was at first thought to be evidence of a hot particle, since it had no relation to results from the other stations. When counted the following day, however, alpha activity appeared to be in line with the other stations, and not unusually high. Again, all Quality Control parameters were acceptable.

Equivalent results for the 100 hour data are shown in Table 3.

Table 3 – 100 hour Gross Alpha Results

Sampler	Mean Conc. (pCi/m^3)	Max Conc (pCi/m^3)	Min Conc (pCi/m^3)	Mean MDA (pCi/m^3)
B1	0.005	0.017	-0.001	0.017
B2	0.006	0.022	-0.002	0.017
B3	0.007	0.019	0.0002	0.018
B4	0.007	0.028	-0.003	0.017
B5	0.004	0.022	-0.004	0.019
B6	0.006	0.019	0.001	0.016

None of the 100 hour data points exceed 0.03 pCi/m^3. Only three points (Station B4 on Nov. 15th, Station B2 on Dec. 10th and Station B5 on December 20th) exceed 0.02 pCi/m^3. The vast majority of 100 hour measurements were less than 0.01 pCi/m^3 and nearly all were below their MDA's, which indicates that the sample count rate was not significantly different than the instrument background. These results are higher than those usually reported by the State in the Quarterly Environmental Surveillance Reports (ESR), where means are usually on the order of 0.005 Pci/m^3 and maximum values rarely exceed 0.01 pCi/m^3[4]. This may be due to the sample locations involved (industrial area vs. buffer zone) or the presence of residual thoron progeny on the filters. Samples from the routine ambient network are usually aged for at least two weeks (336 hours) before counting. MDAs reported in the ESRs are considerably lower, due to the larger sample volumes collected by the ambient network

Regression analysis was performed in order to examine the relationship between gross alpha radioactivity and Total Suspended Particulate (TSP) material in air No significant relationship was observed Additional discussion of this analysis can be found in Appendix B

DISCUSSION:

The most obvious lesson of this project is that 72 hours is not enough time for all of the short-lived airborne radioactivity to decay. Average gross alpha measurements declined by a factor of more than six in the additional day, while gross beta measurements declined by a factor of 2.5 While the products of Rn-222 will decay to insignificance within 24 hours, Pb-212 (a product of Rn-220 decay with a half-life of 10.6 hours) and its decay products will persist on an air filter at detectable levels for at least 100 hours. To obtain maximum sensitivity filters must be aged for at least this length of time

While the choice of 0.1 mrem as an action level has some value, the assumptions that are built into its determination (all alpha from WGPu, continuous exposure for one year) are overly conservative and unrealistic. Its relationship to the detection limit at a given location is highly variable, while it is prone to be misunderstood by those not familiar with dosimetric modeling As we have shown, values that exceed 0.02 pCi/m^3 after 100 hours are very rare, and values over 0.03 pCi/m^3 are nonexistent, regardless of the distance or direction from the building, while detection limits at or below 0.02 pCi/m^3 are achievable. These data would indicate that any measurement exceeding 0.03 pCi/m^3 after 100 hours is above background, and could represent a release This or some higher value could be chosen to prompt isotopic analysis and dose assessment, without any preconceived notions of dose clouding the judgement of either site personnel or regulators

The cost of this monitoring effort was not trivial, even when no isotopic analysis was performed The length of the sampling day resulted in significant overtime pay for field personnel, while the requirement to count the samples after 72 hours forced LARS staff to work several hours each weekend. These additional costs must be considered in any discussion of such monitoring in the future

Information gathered through such protocols can complement the existing sampling networks by informing Site management and regulators when activity above background levels is observed Used in conjunction with meteorologic data and samples from the existing networks, the parties may determine the extent and degree of offsite impact, if any If necessary, isotopic analysis of the appropriate filters could then be expedited in order to assess doses both on and offsite

If project management is required to keep a daily log of building areas demolished, related activities and other observations, it is possible that such a release could be tied to specific building areas and/or events, allowing lessons to be learned that might apply to the next demolition project

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CONCLUSIONS:
It is clear that these sampling and analysis protocols are adequate to detect significant releases of long-lived alpha emitters. It is equally clear that this information will not be available in time for project management or regulators to mitigate the release Thus, air monitoring of this sort does not protect either the on-site or the off-site population, but would document releases at lower levels than are currently available through either the Site or the State routine ambient networks

DQOs for future demolition monitoring should reflect the additional time needed for decay of short-lived radionuclides such as Pb-212 Ninety six to 120 hours is a minimum requirement when the samples are counted on a proportional counter configured as CDPHE's is

Modelling to determine dose levels is unnecessary, now that good baseline data have been collected DQOs for future demolition monitoring should tie isotopic analysis and other possible actions to these or other valid background measurements

22

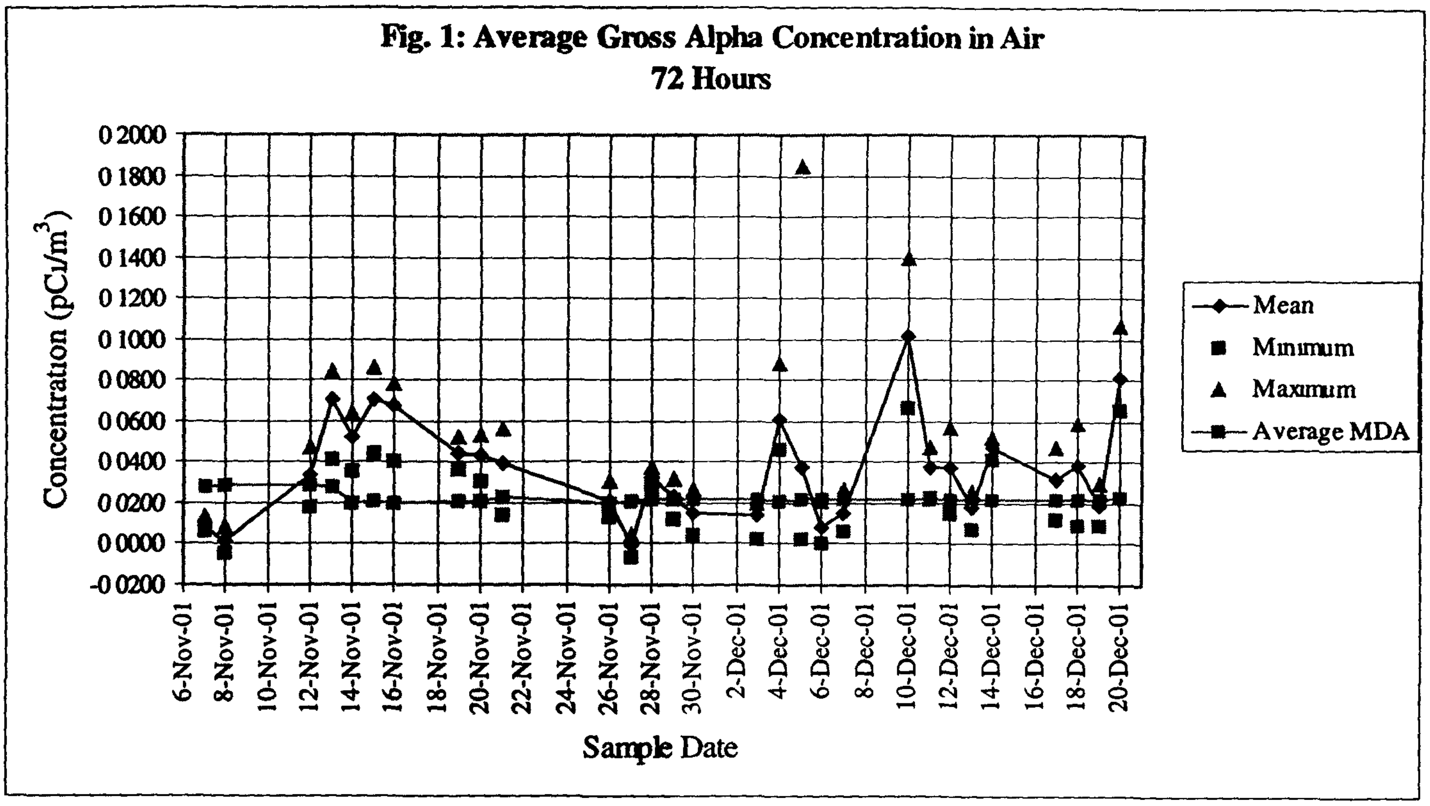


Fig. 1: Average Gross Alpha Concentration in Air
72 Hours
Concentration (pCi/m³)
Sample Date
Mean
Minimum
Maximum
Average MDA

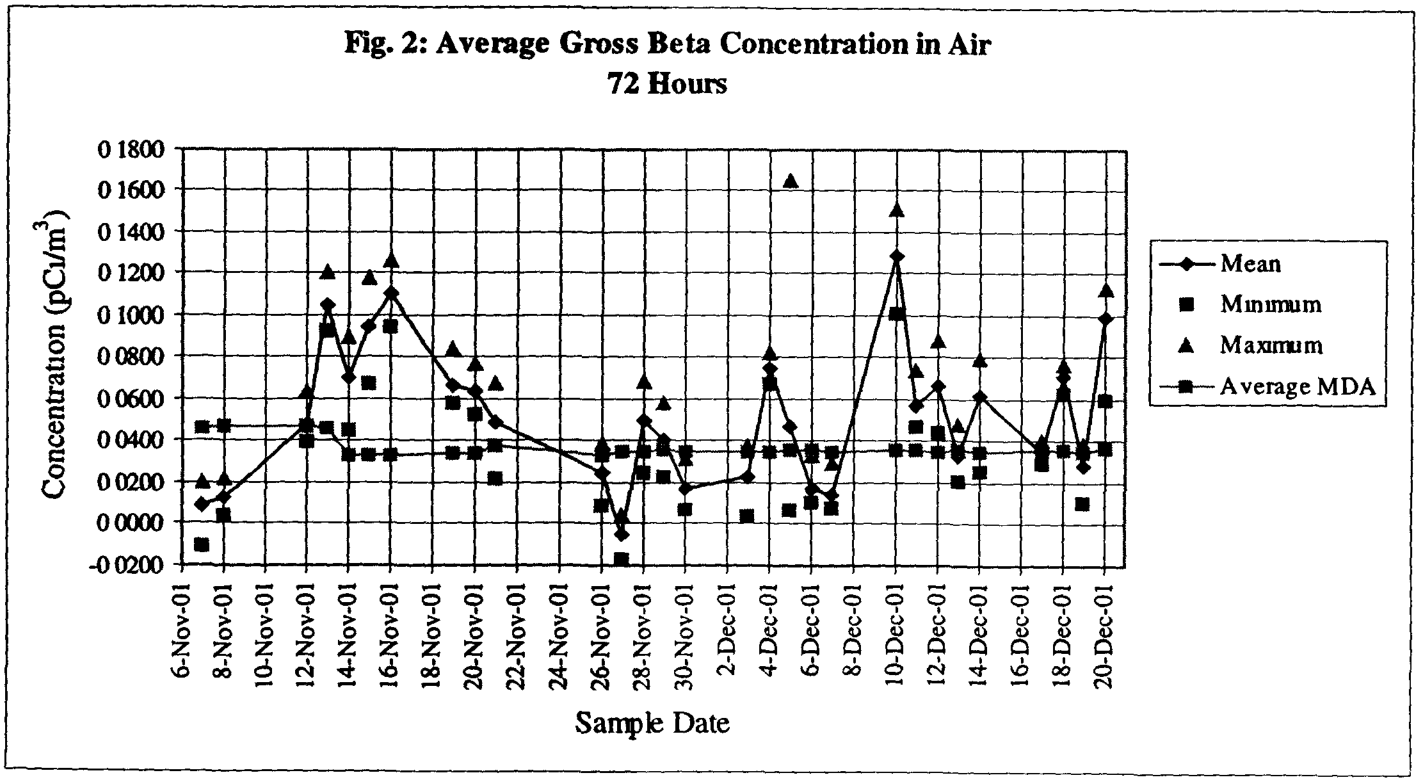


Fig. 2: Average Gross Beta Concentration in Air
72 Hours
Concentration (pCi/m³)
Sample Date
Mean
Minimum
Maximum
Average MDA

23

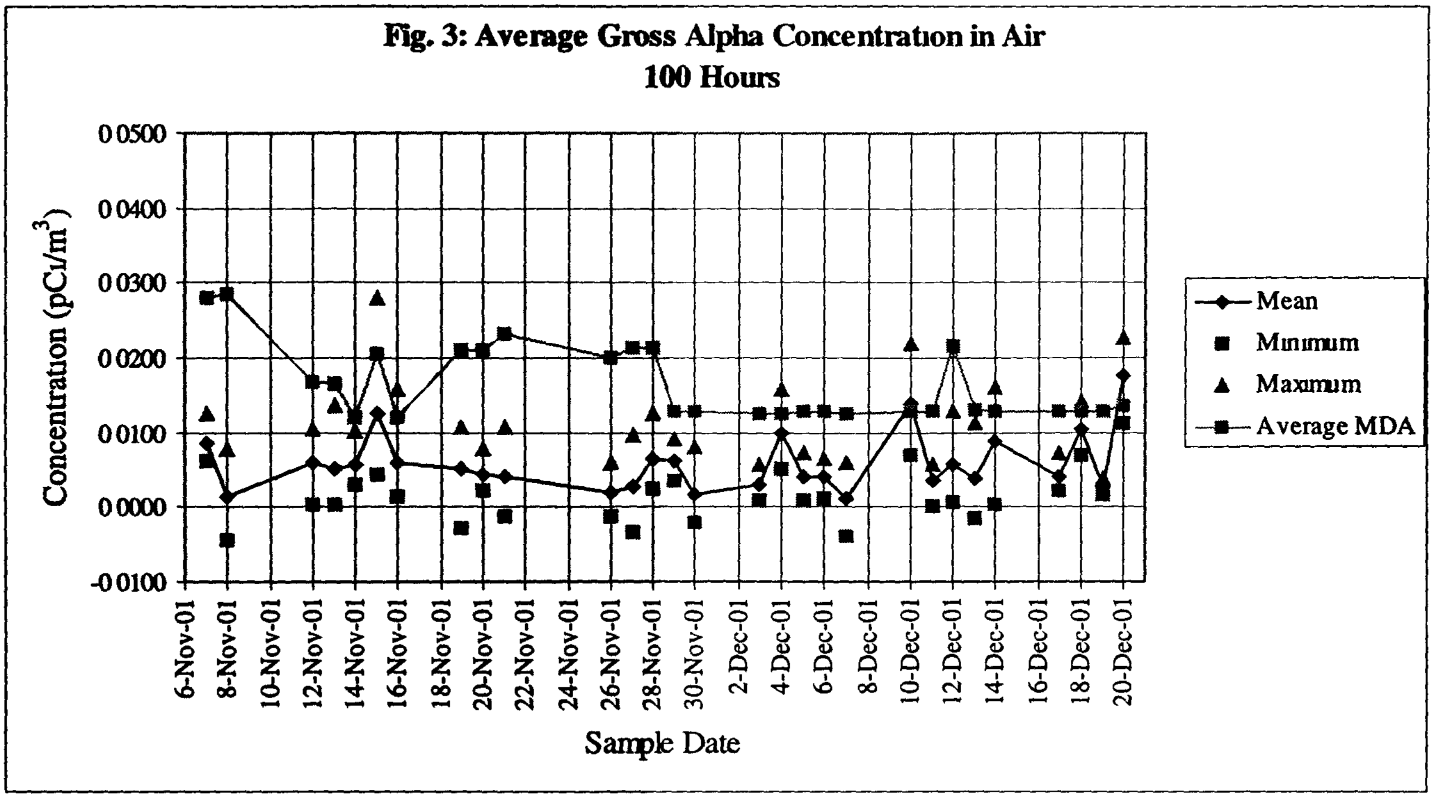


Fig. 3: Average Gross Alpha Concentration in Air
100 Hours
Concentration (pCi/m³)
0 0500
0 0400
0 0300
0 0200
0 0100
0 0000
-0 0100
6-Nov-01
8-Nov-01
10-Nov-01
12-Nov-01
14-Nov-01
16-Nov-01
18-Nov-01
20-Nov-01
22-Nov-01
24-Nov-01
26-Nov-01
28-Nov-01
30-Nov-01
2-Dec-01
4-Dec-01
6-Dec-01
8-Dec-01
10-Dec-01
12-Dec-01
14-Dec-01
16-Dec-01
18-Dec-01
20-Dec-01
Sample Date
Mean
Minimum
Maximum
Average MDA

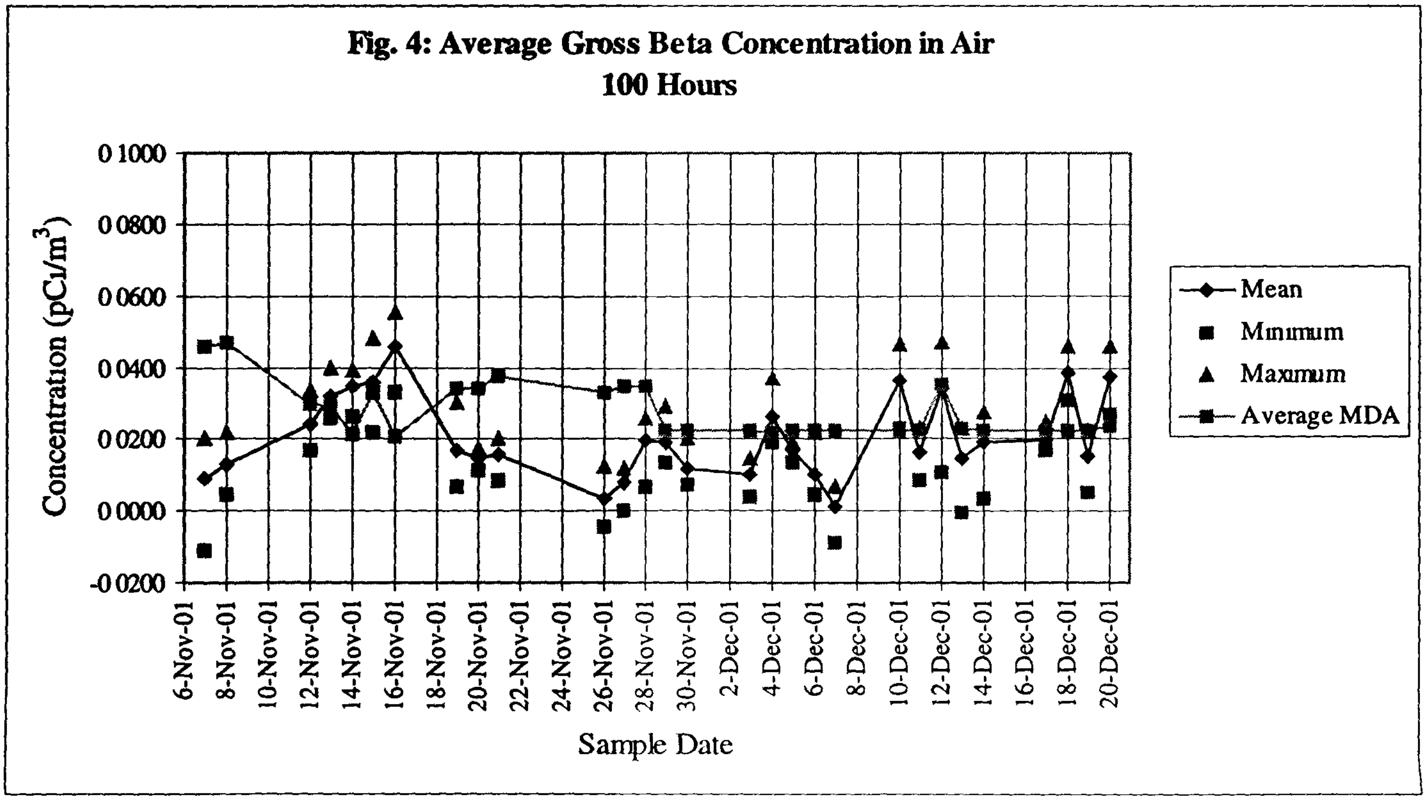


Fig. 4: Average Gross Beta Concentration in Air
100 Hours
Concentration (pCi/m³)
0 1000
0 0800
0 0600
0 0400
0 0200
0 0000
-0 0200
6-Nov-01
8-Nov-01
10-Nov-01
12-Nov-01
14-Nov-01
16-Nov-01
18-Nov-01
20-Nov-01
22-Nov-01
24-Nov-01
26-Nov-01
28-Nov-01
30-Nov-01
2-Dec-01
4-Dec-01
6-Dec-01
8-Dec-01
10-Dec-01
12-Dec-01
14-Dec-01
16-Dec-01
18-Dec-01
20-Dec-01
Sample Date
Mean
Minimum
Maximum
Average MDA

24

Fig. 5: Station B1 - 72 Hour Gross Alpha Activity

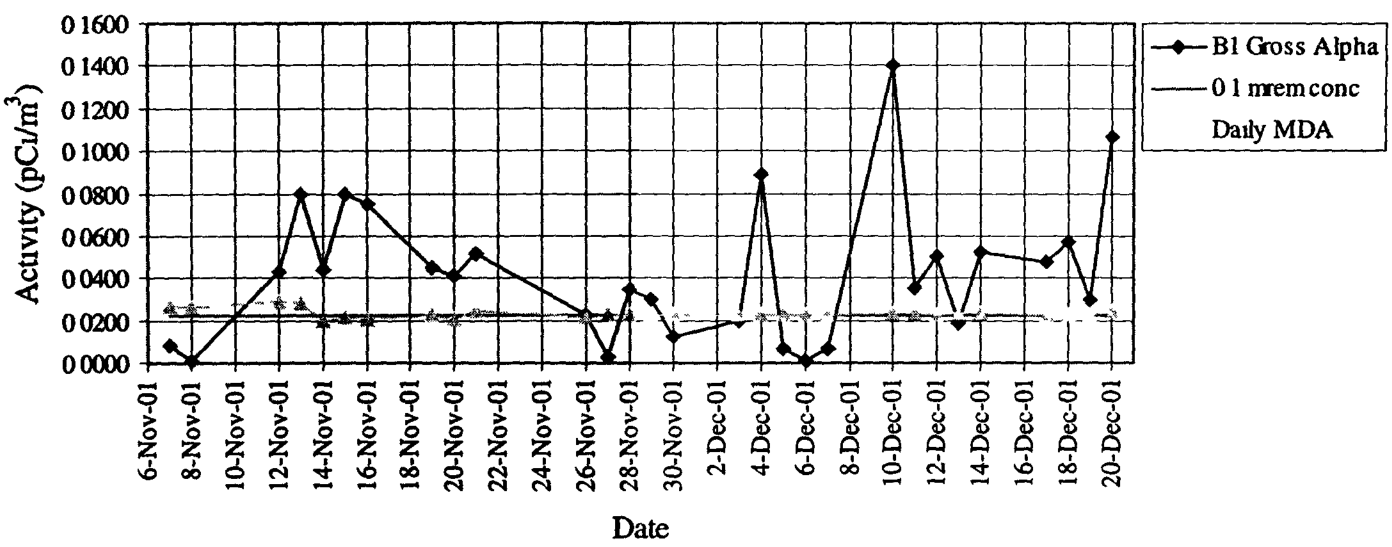
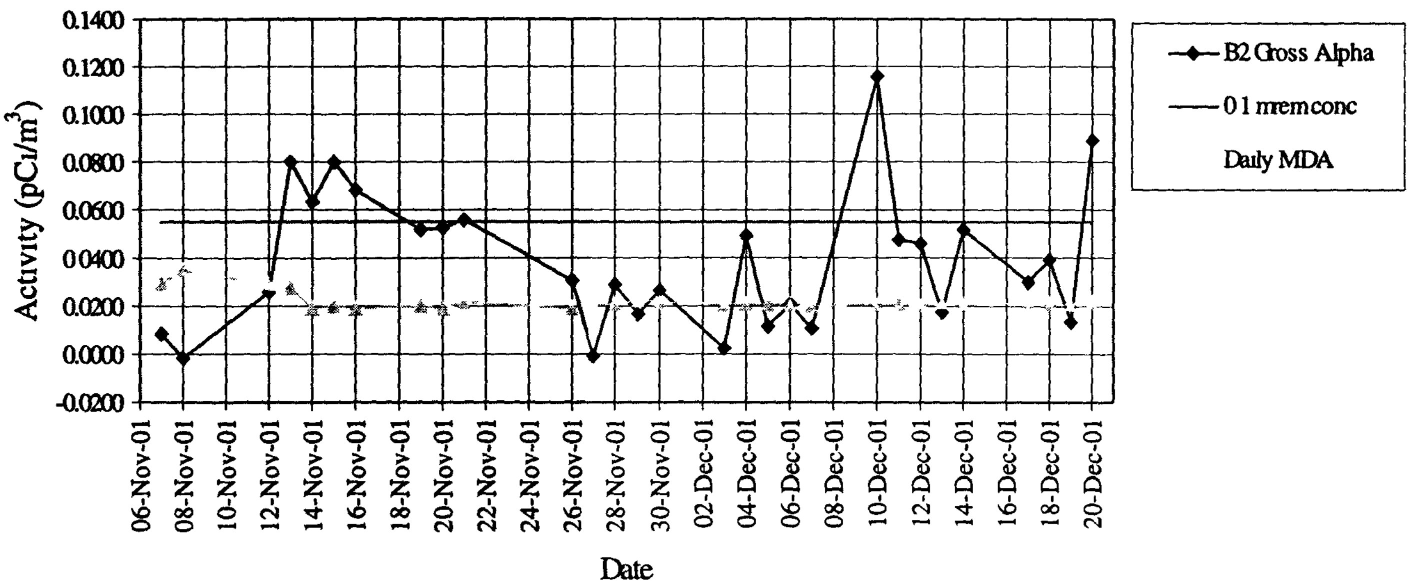


Fig. 6: Station B2 - 72 Hour Gross Alpha Activity



25

Fig. 7: Station B3 - 72 Hour Gross Alpha Activity

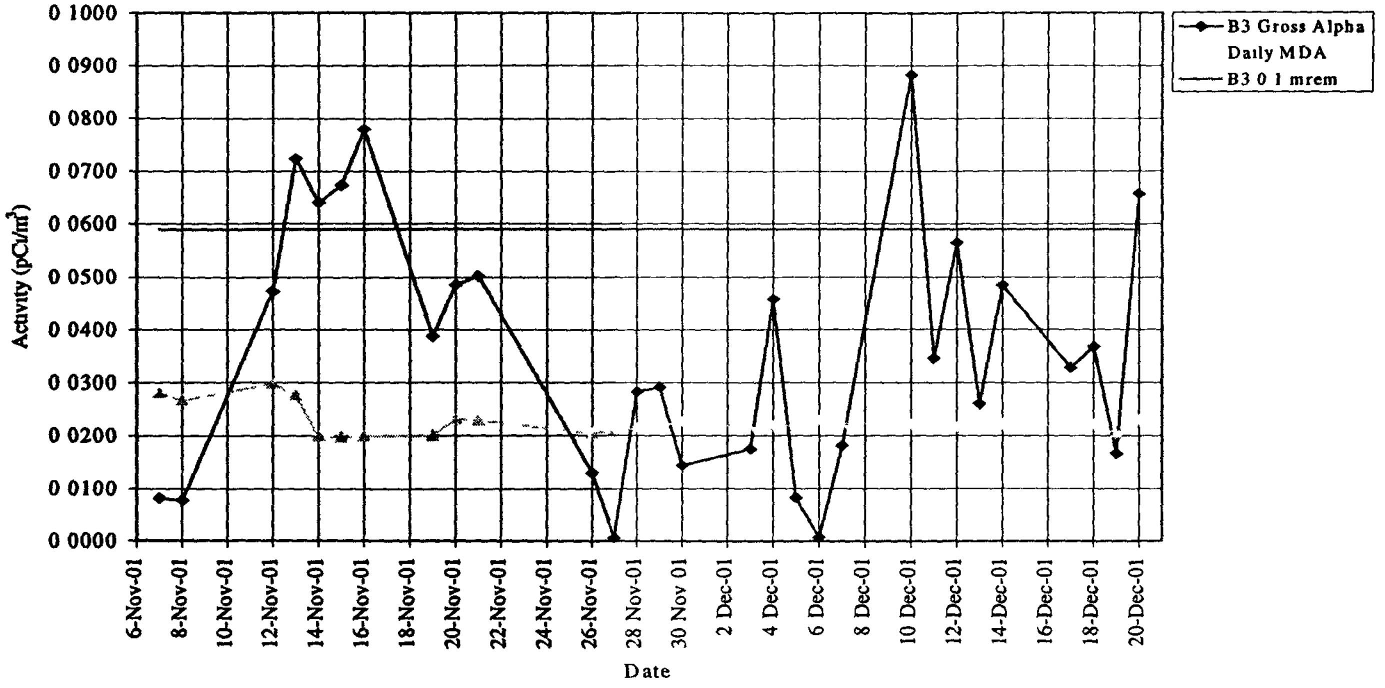


Fig. 8: Station B4 - 72 Hour Gross Alpha Activity

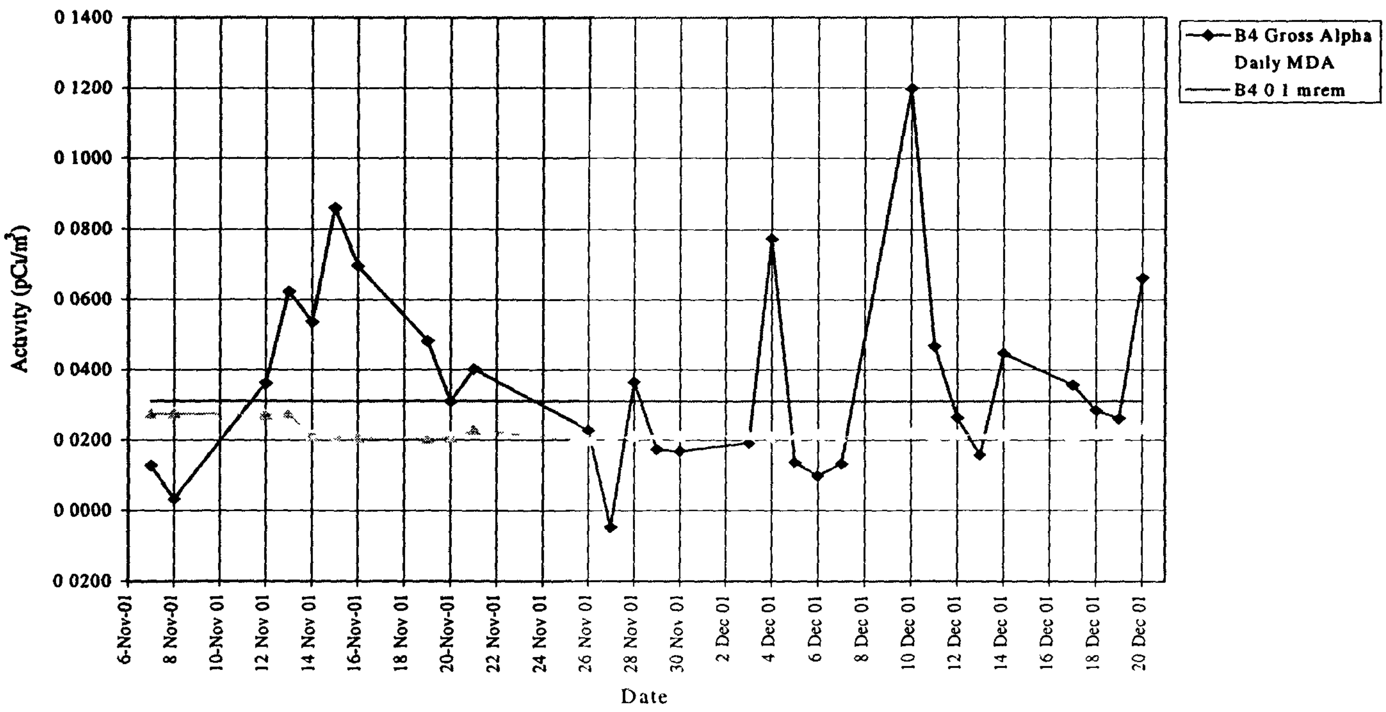


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Fig. 9: Station B5 - 72 Hour Gross Alpha Activity

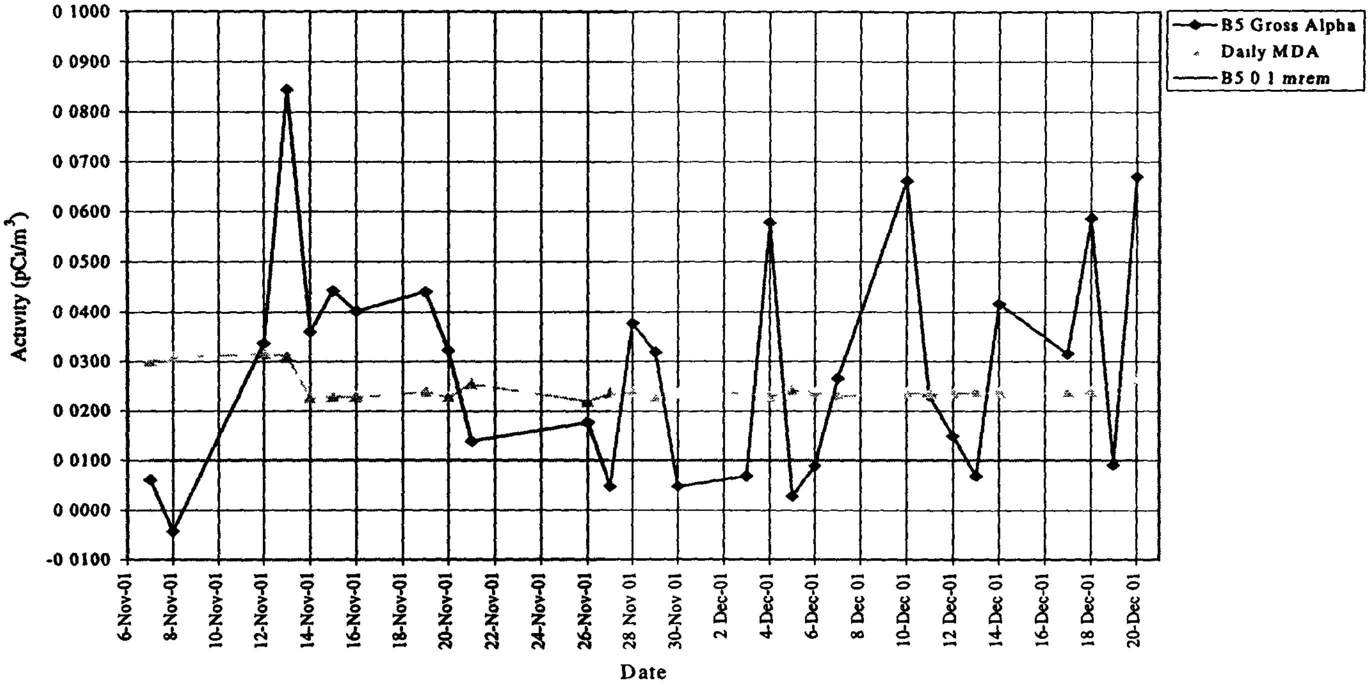
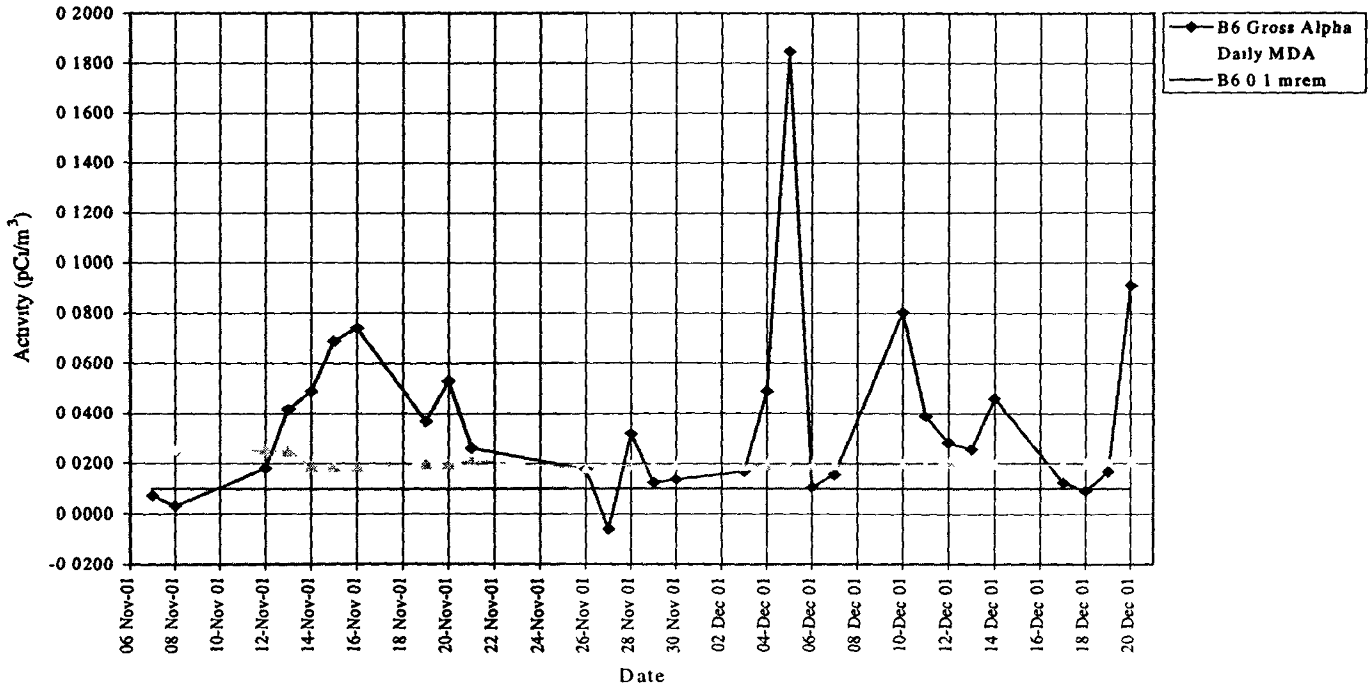


Fig. 10: Station B6 - 72 Hour Gross Alpha Activity



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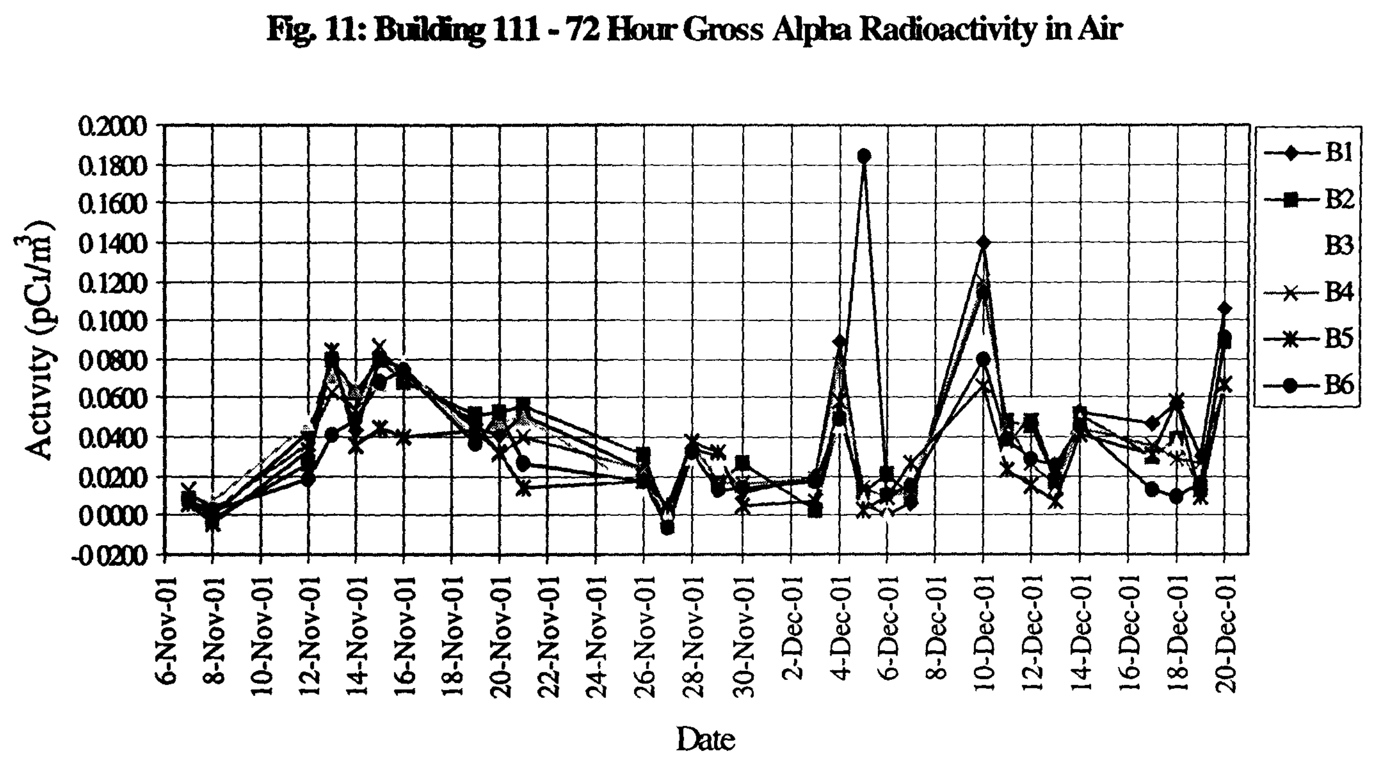

Fig. 11: Building 111 - 72 Hour Gross Alpha Radioactivity in Air
Activity (pCi/m³)
0.2000
0.1800
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
-0.0200
6-Nov-01
8-Nov-01
10-Nov-01
12-Nov-01
14-Nov-01
16-Nov-01
18-Nov-01
20-Nov-01
22-Nov-01
24-Nov-01
26-Nov-01
28-Nov-01
30-Nov-01
2-Dec-01
4-Dec-01
6-Dec-01
8-Dec-01
10-Dec-01
12-Dec-01
14-Dec-01
16-Dec-01
18-Dec-01
20-Dec-01
Date
B1
B2
B3
B4
B5
B6

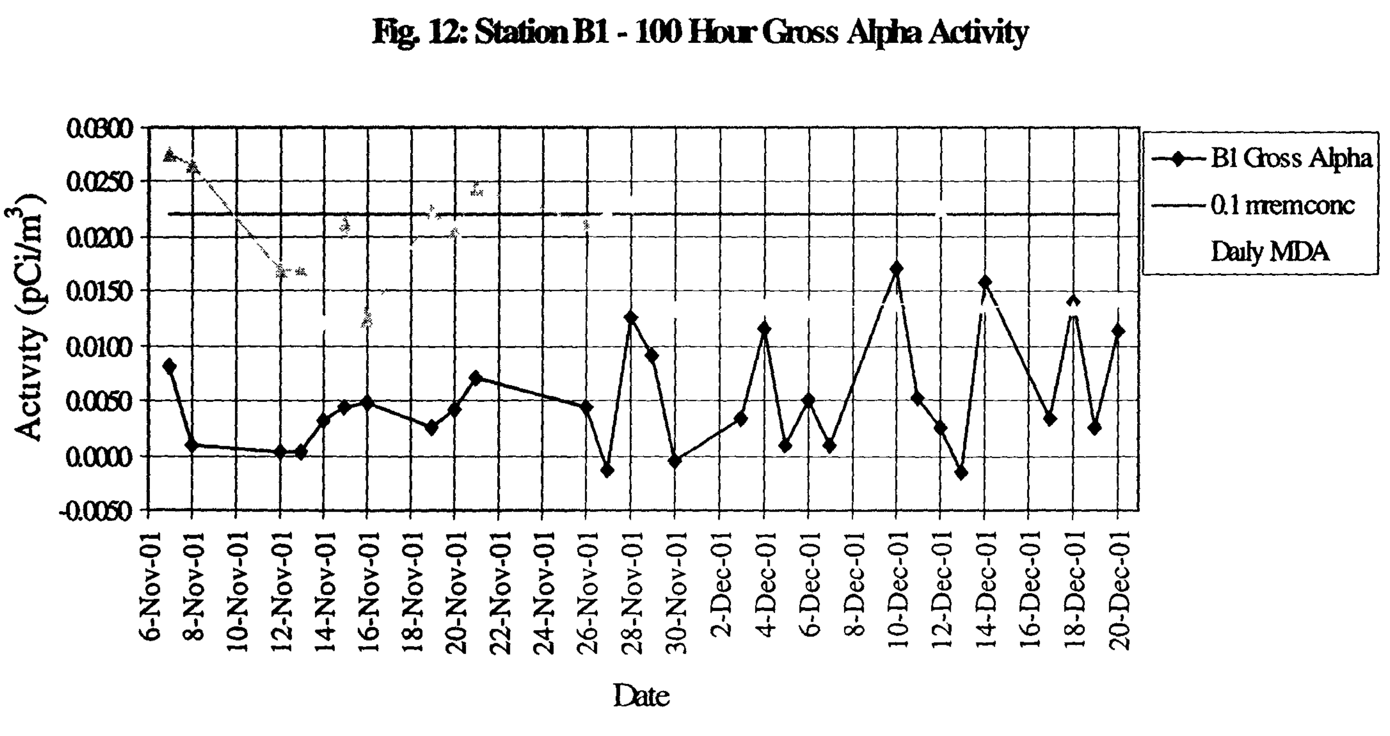

Fig. 12: Station B1 - 100 Hour Gross Alpha Activity
Activity (pCi/m³)
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
-0.0050
6-Nov-01
8-Nov-01
10-Nov-01
12-Nov-01
14-Nov-01
16-Nov-01
18-Nov-01
20-Nov-01
22-Nov-01
24-Nov-01
26-Nov-01
28-Nov-01
30-Nov-01
2-Dec-01
4-Dec-01
6-Dec-01
8-Dec-01
10-Dec-01
12-Dec-01
14-Dec-01
16-Dec-01
18-Dec-01
20-Dec-01
Date
B1 Gross Alpha
0.1 mremconc
Daily MDA

28

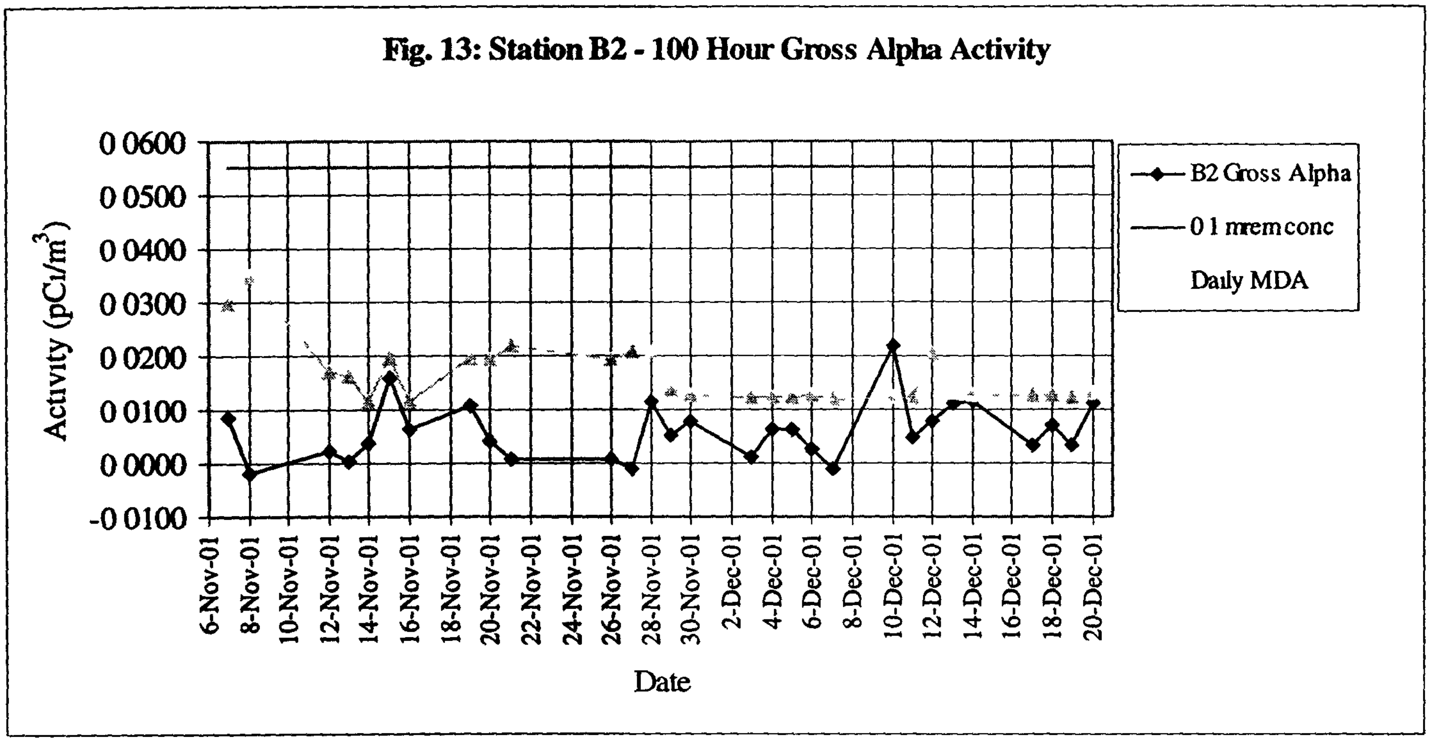
Fig. 13: Station B2 - 100 Hour Gross Alpha Activity
Activity (pCi/m^3)
Date
B2 Gross Alpha
0 1 mrem conc
Daily MDA

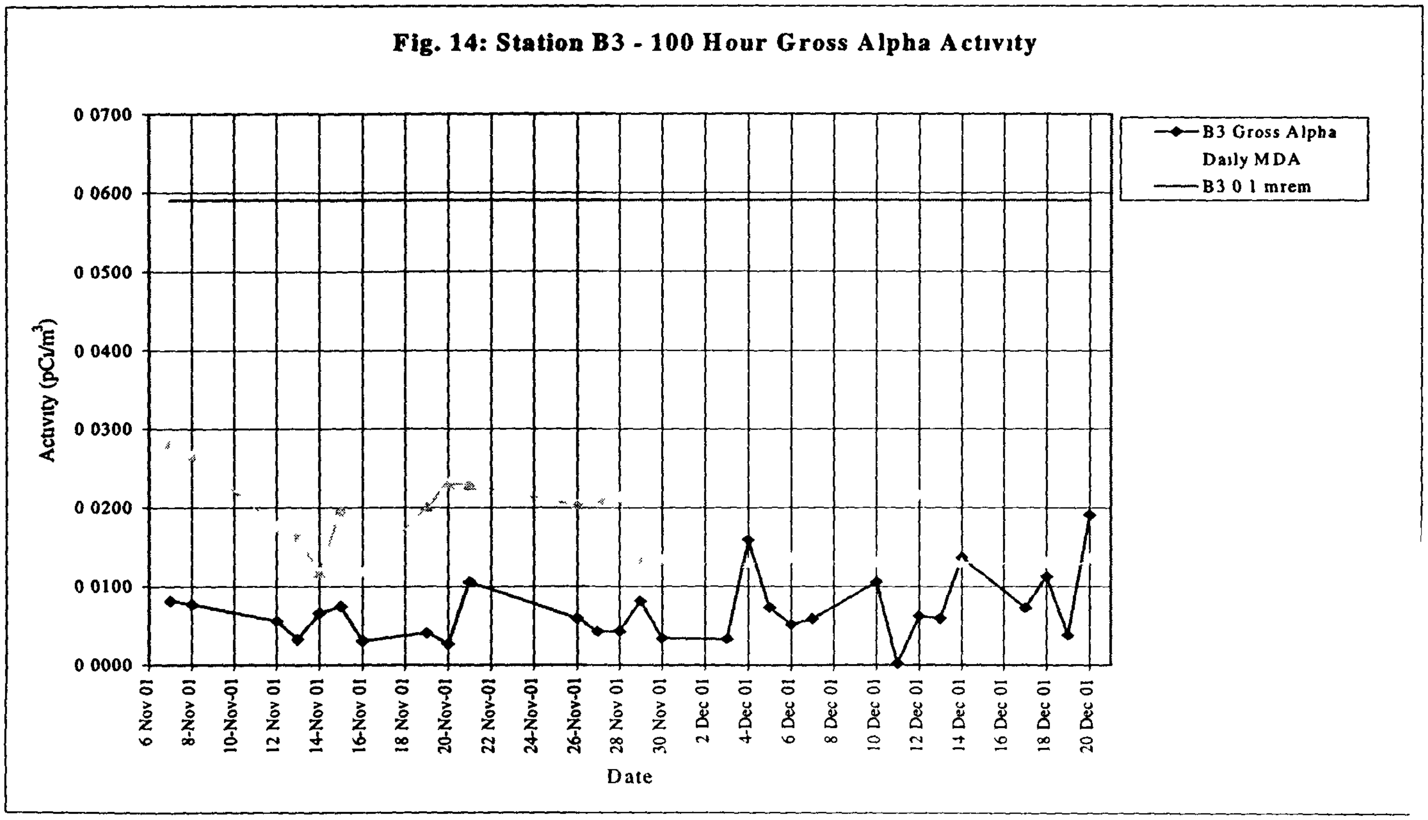
Fig. 14: Station B3 - 100 Hour Gross Alpha Activity
Activity (pCi/m^3)
Date
B3 Gross Alpha
Daily MDA
B3 0 1 mrem

29

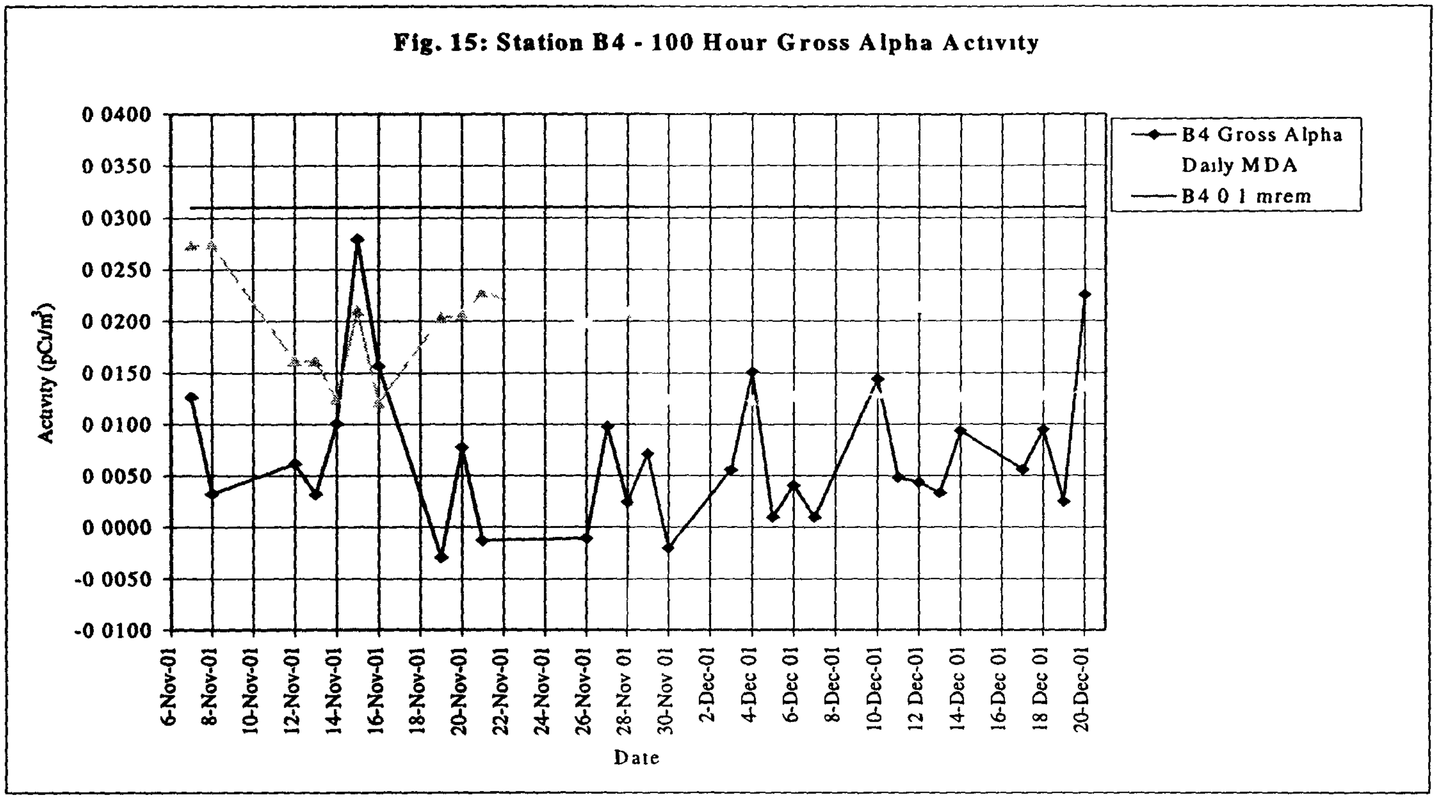
Fig. 15: Station B4 - 100 Hour Gross Alpha Activity
B4 Gross Alpha
Daily MDA
B4 0 1 mrem
Activity (pCi/m³)
Date

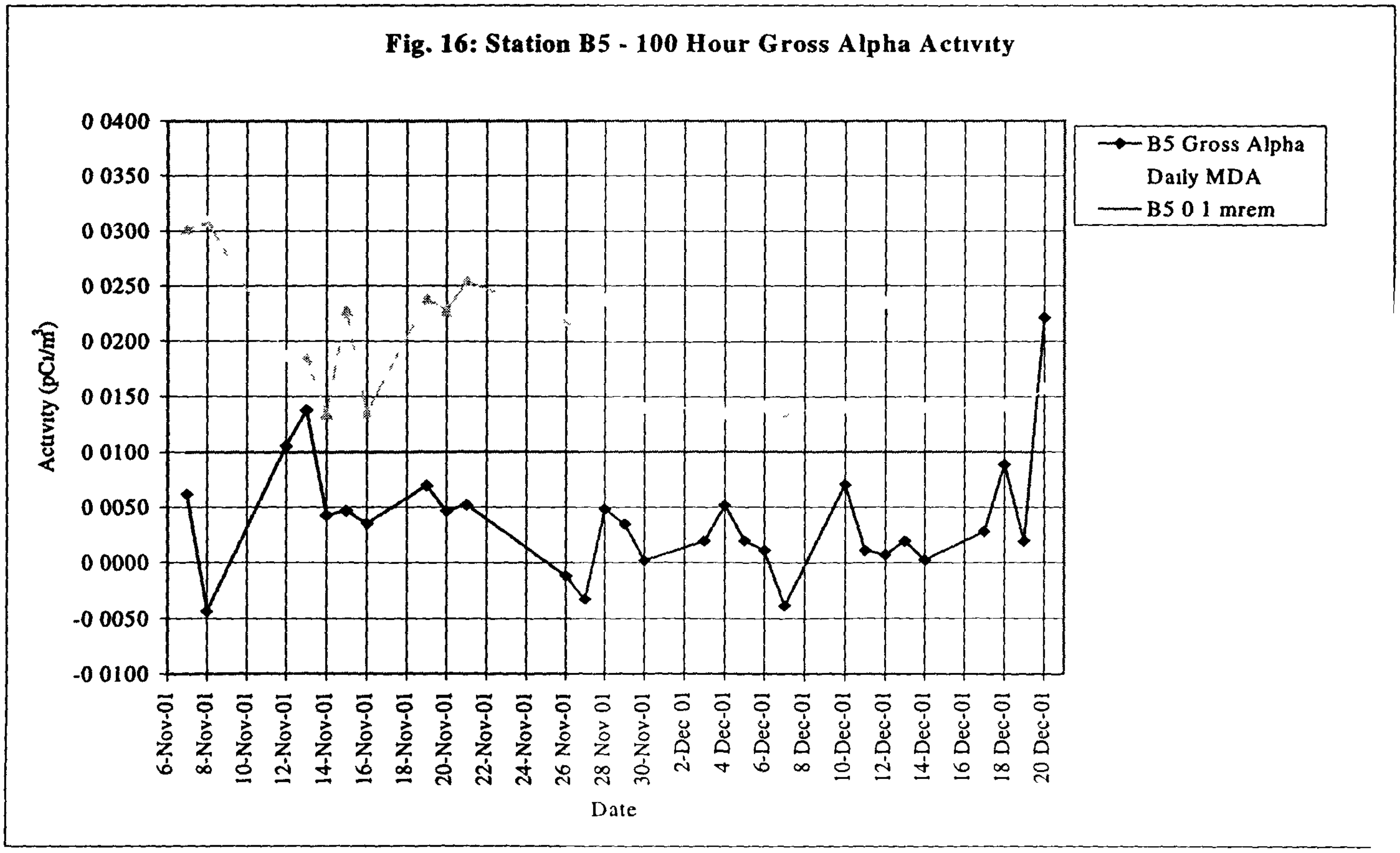
Fig. 16: Station B5 - 100 Hour Gross Alpha Activity
B5 Gross Alpha
Daily MDA
B5 0 1 mrem
Activity (pCi/m³)
Date

30

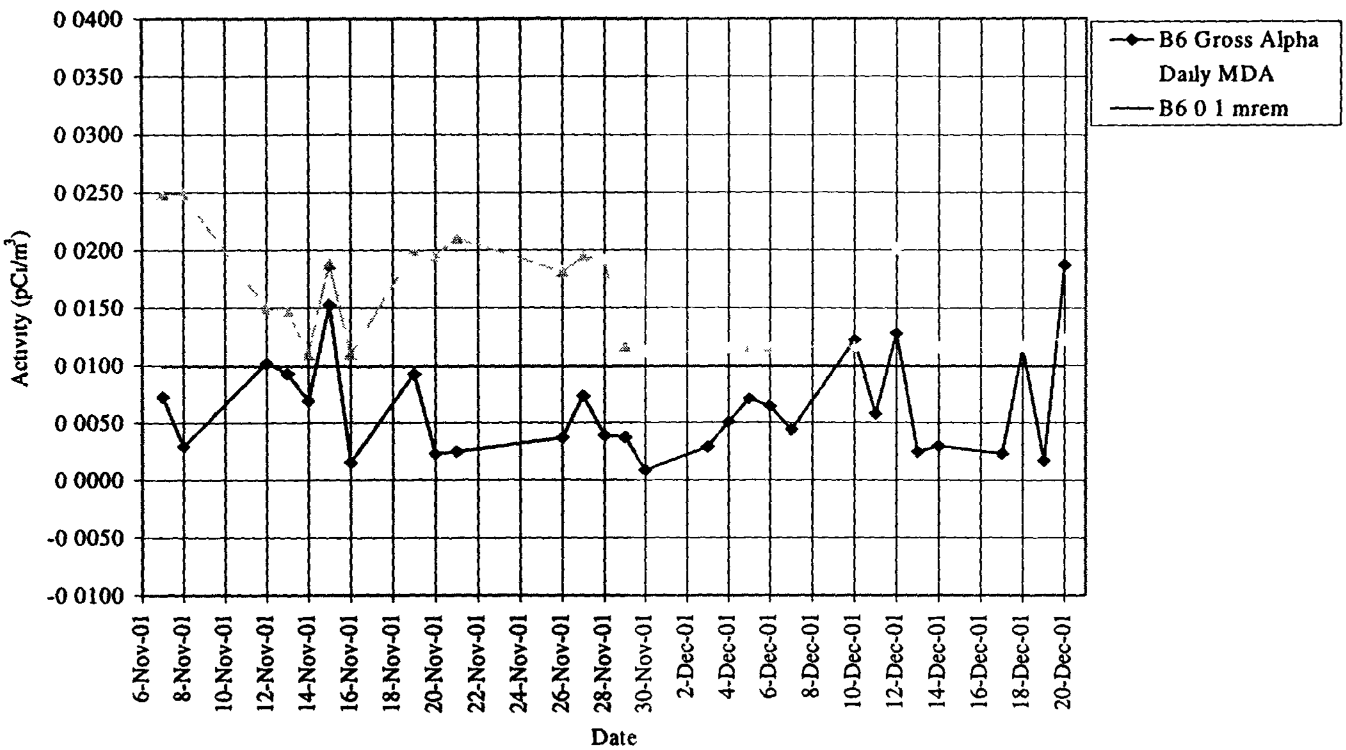

Fig. 17: Station B6 - 100 Hour Gross Alpha Activity

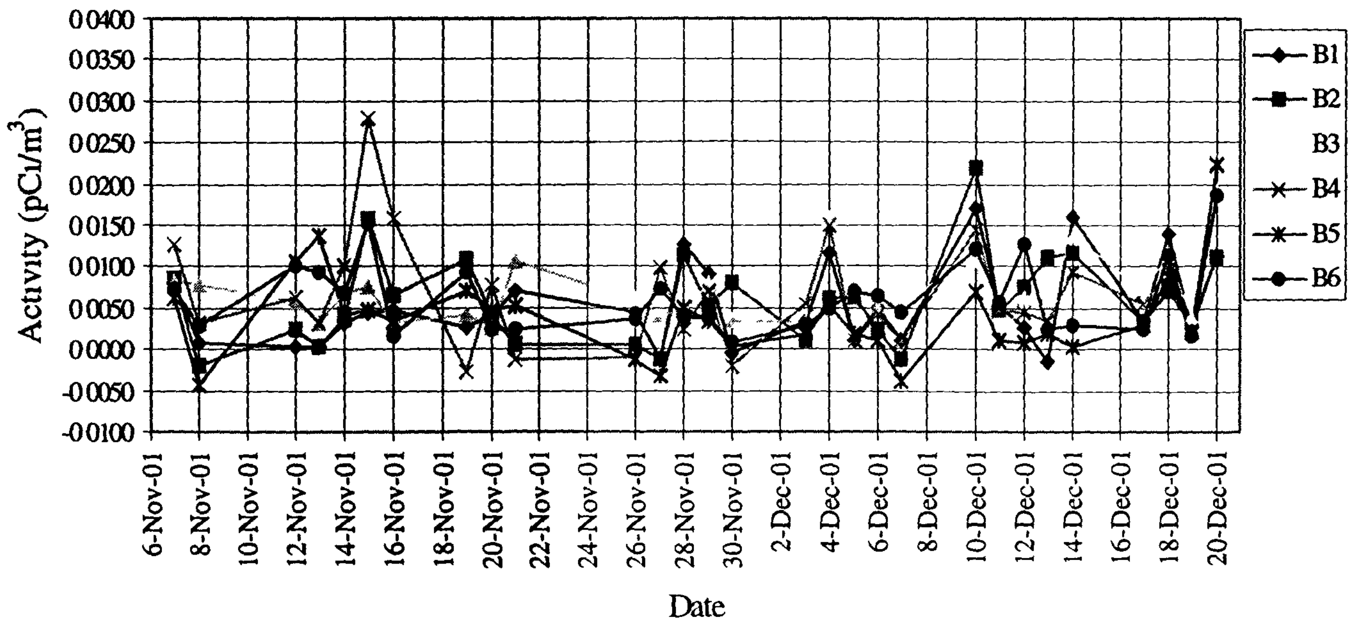

Fig. 18: Building 111 - 100 Hour Gross Alpha Radioactivity in Air

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Appendix A –Naturally Occurring Radioactivity in Air

Current technology limits analysis of plutonium at environmental levels to methods that require weeks to obtain accurate results This pilot study evaluated the use of gross alpha measurements of air filters as an alternative to the more time consuming methods Alpha particles are emitted from a variety of radionuclides, including many that are naturally occurring [5] Alpha emitting radionuclides with short (e g <10 days) half-lives include radon-222, polonium-218 and polonium-212. These (and other) radionuclides are ubiquitous in outdoor air When large volumes of air are forced through filters these nuclides accumulate in surprisingly high numbers, and, if the filters are counted with alpha detectors soon after sampling, very high count rates may be observed Because these nuclides have short half-lives, the amount of radioactivity declines quickly and, within a few days, little or no measurable radioactivity remains

Other radionuclides, such as uranium-238, radium-226 and plutonium-239 have half-lives measured in thousands of years. When significant amounts of these are collected on air filters, the count rates observed do not change measurably for many years When small amounts of these nuclides are collected along with the short-lived nuclides described above, it is nearly impossible to detect them until the short-lived nuclides have decayed away

In this study we are concerned with two sources of short-lived alpha emitters in air, radon-222 (radon) from the uranium decay series, and radon-220 (thoron) from the thorium decay series These nuclides each give rise to a unique series of short lived alpha emitters, known as decay products or progeny As shown on Figure A1 below, activity from thoron progeny in ambient air is equal to about 5% of the activity from radon progeny one hour after collection of an air sample After about 24 hours, the radon progeny have decayed to their minimum activity, but activity from thoron progeny is still relatively high Activity from thoron progeny does not reach an equivalent level until about 300 hours after sample collection

The Y axis in Figure A1 is the relative activity measured from the end of the sampling period, assuming that thoron activity in air is 0 2% of radon activity, an average value for North America (6) Activity from radon progeny eventually begins to increase as lead-210 (half-life = 22 3 years) decays to polonium-210 True values of Po-210 are somewhat higher, as Figure A1 includes only lead-210 arising from the radon, and not ambient lead-210 already present in the air

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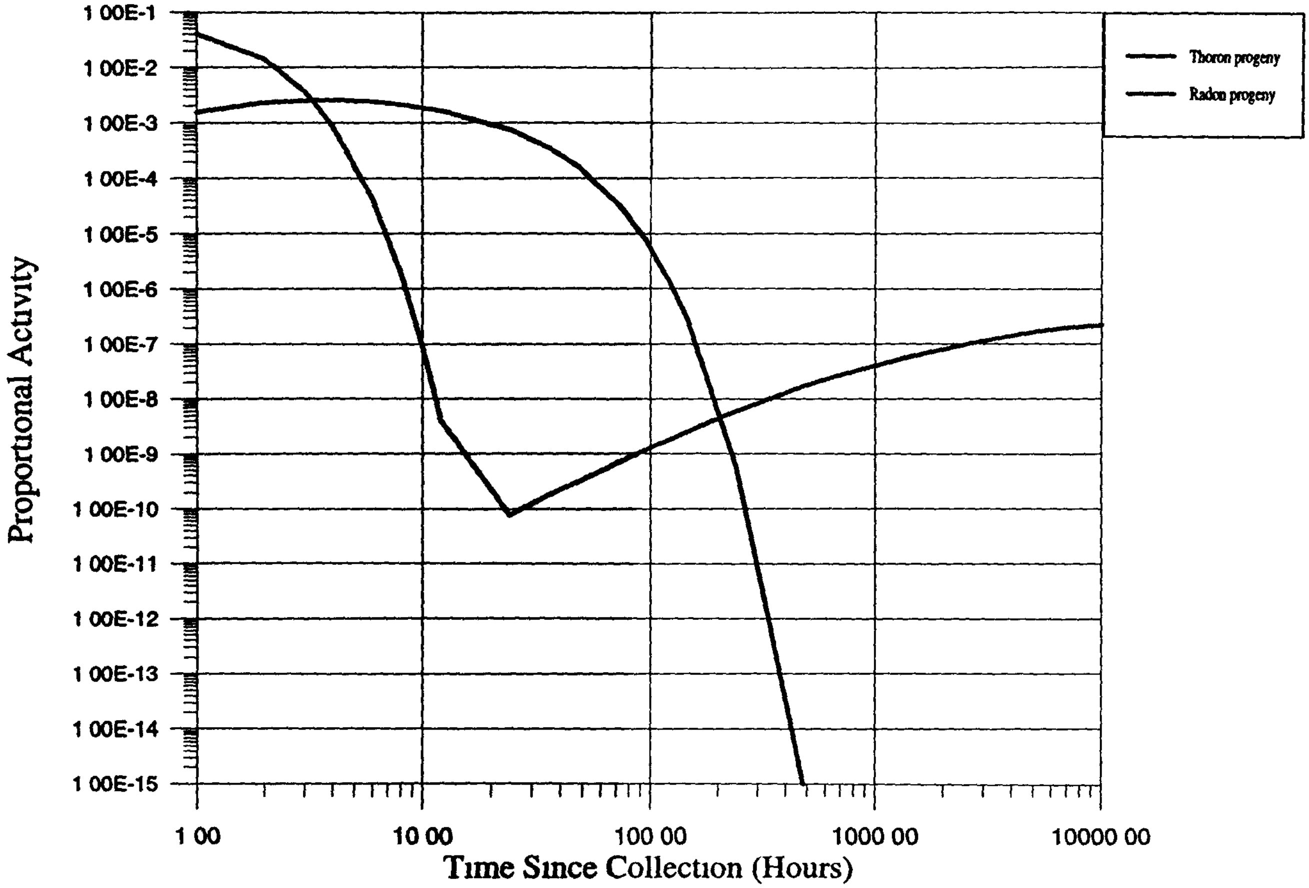
Fig. A1 - Naturally Occurring Alpha Radioactivity on Air Filters
Decay with Time



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Appendix B – Regression Analysis of Gross Alpha Radioactivity on Total Suspended Particulate Material in Air

Regression analysis of the 72 hour gross alpha data on the measured TSP material showed the relationship shown in Figure B1, with the mathematical form

$$\text{Alpha} = 7\ 1\text{e-}5\ (\text{TSP}) + 0\ 0311$$

for the best fit line This relationship barely obtained statistical significance ($R^2 = 0\ 03$, $p =\ 03$) This is not surprising since, at 72 hours, we are still largely measuring thoron decay products that have little or no relationship to the dust accumulated on a filter, and whose mass is insignificant

When the 100 hour data was used, (Figure B2) the dependence of gross alpha activity on TSP mass was somewhat more evident. Expressing the best fit line as an equation we get

$$\text{Alpha} = 3\ 9\text{e-}5\ (\text{TSP}) + 0\ 0027$$

with $R^2 = 0\ 24$ and $p = 5E\text{-}12$ Although statistically significant, it is clear that this equation would

Fig. B1 - 72 Hour Gross Alpha vs. TSP

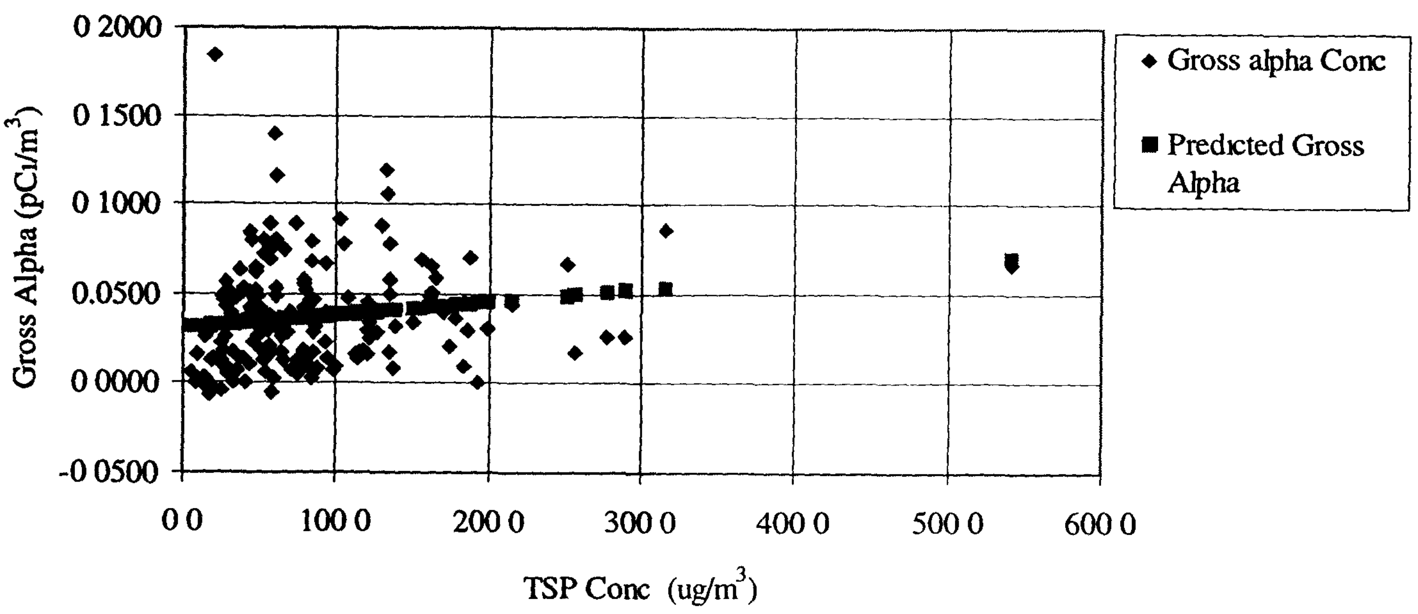

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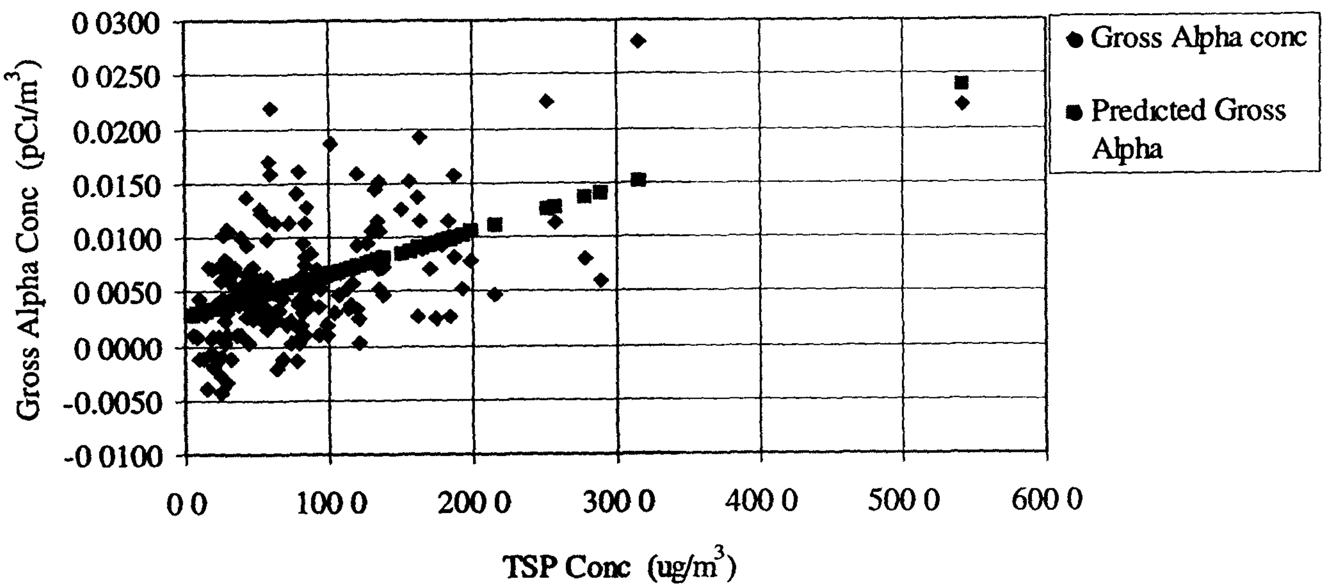
Fig. B2 - 100 Hour Gross Alpha vs TSP conc.



not be very useful for predicting gross alpha values from TSP measurements

Since one of the last samples collected had the highest TSP mass and a relatively high gross alpha value, we investigated the influence of this point by performing the regression analysis without it Results are shown in Figure B3 The regression equation changed slightly, to

$$\text{Alpha} = 4\ 1\text{e-}5\ (\text{TSP}) + 0\ 0026$$

while R^2 decreased to 0 20 ($p = 5E\text{-}10$). Thus this point did not exert any undue influence on the regression analysis

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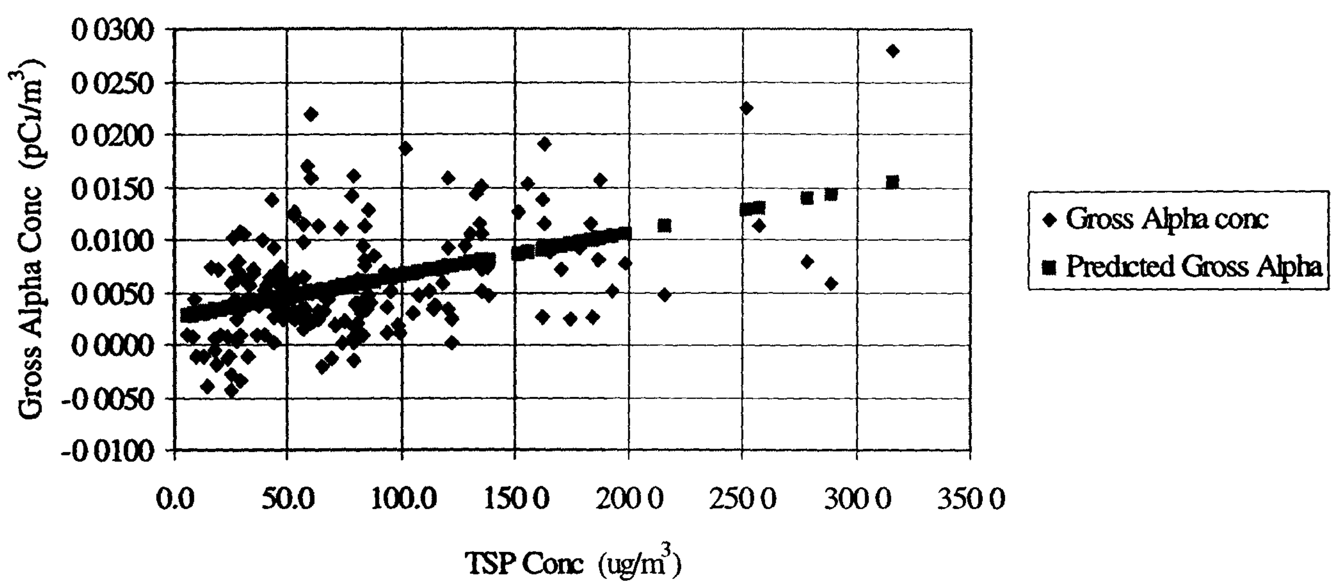

Fig. B3 - 100 Hour Gross Alpha vs TSP conc.

Regression analysis demonstrates that gross alpha activity is weakly related to TSP concentration, but nearly all the gross alpha data used in the analysis was below the MDA Lower MDA's would be achievable through higher volume samples, longer count times, or both, but only the former is realistic with the current limitations on our laboratory Data above the MDA would have smaller uncertainties, and would presumably yield a more meaningful regression equation

REFERENCES:

1 Garcia, Shirley, Letter from City of Broomfield to Kaiser-Hill Environmental Restoration, Aug 15, 2001

2 Kruchek, David, Colorado Dept. of Public Health & Environment, Personal communication, 2001

3 Kaiser-Hill, B-779 Demolition Monitoring Report, August, 2001

4. Colorado Dept. of Public Health & Environment, Environmental Surveillance Report on the U S Department of Energy Rocky Flats Environmental Technology Site, Third Quarter 2001, November, 2001

5 Committee on the Biological Effects of Ionizing Radiations, National Research Council, Health Risks of Radon and Other Internally Deposited Alpha-Emitters (BEIR IV), National Academy Press, Washington, D C , 1988.

6 National Council on Radiation Protection and Measurement, Exposure of the Population of the United States and Canada from Natural Background Radiation, NCRP Report No 94, 1987

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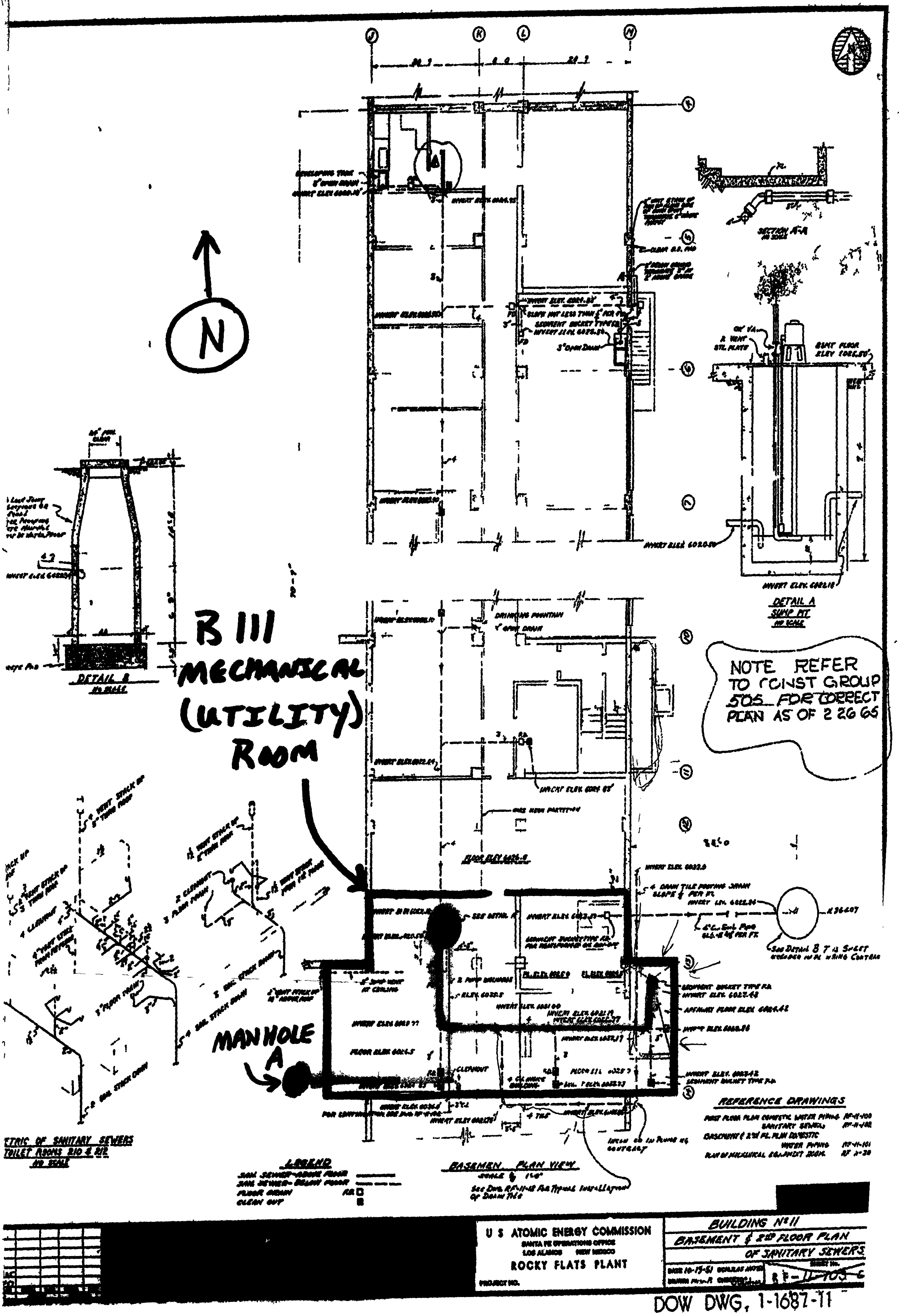
N
B111 MECHANICAL (UTILITY) ROOM
MANHOLE A
NOTE REFER TO CONST GROUP 505 FOR CORRECT PLAN AS OF 2 26 65
SECTION A-A NO SCALE
DETAIL A SUMP PIT NO SCALE
DETAIL B NO SCALE
DRINKING FOUNTAIN
ETRIC OF SANITARY SEWERS TOILET ROOMS 210 & 212 NO SCALE
LEGEND
SAN. SEWER-ABOVE FLOOR
SAN. SEWER-BELOW FLOOR
FLOOR DRAIN
CLEAN OUT
BASEMENT PLAN VIEW
REFERENCE DRAWINGS
U S ATOMIC ENERGY COMMISSION
SANTA FE OPERATIONS OFFICE
LOS ALAMOS NEW MEXICO
ROCKY FLATS PLANT
PROJECT NO.
BUILDING No 11
BASEMENT & 2nd FLOOR PLAN
OF SANITARY SEWERS
DOW DWG. 1-1687-11